

Institution: Cardiff University

Unit of Assessment 4: Psychology, Psychiatry and Neuroscience

1. Unit context and structure, research and impact strategy

1.1. Context and structure

The College of Biomedical and Life Sciences is home to staff from the Schools of Psychology and Medicine (the Division of Psychological Medicine and Clinical Neurosciences). Consistent with REF 2014, these staff form the basis of our submission to UOA4 for REF 2021, with an increase in returned staff from **69.33 to 116.09 FTE**.

Our research concerns the science of human and animal behaviour, as a foundation to understanding the nature and treatment of a broad range of psychiatric, neurodevelopmental and neurological disorders. We have 7 research themes: Social & Environmental Psychology; Health & Developmental Psychology; Developmental Psychiatry; Psychosis & Major Affective Disorders; Neurodegenerative Disorders; Cognitive Science; and Neuroscience. These themes generate social, medical, and economic impacts across three interacting domains: Environmental Sustainability; Health & Wellbeing; and Enterprise.

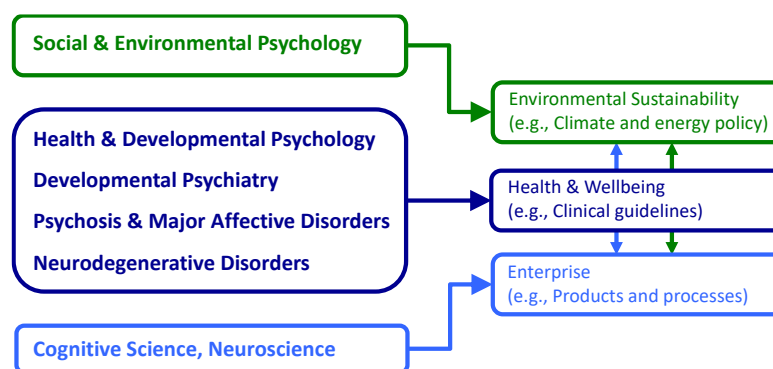


Figure 1. How our 7 underpinning research themes support our research impact.

Our research and impact is driven by people who work in a vibrant and supportive environment (Section 2), with shared access to infrastructure and state-of-the-art facilities (Section 3), enabling extensive local, national and international interdisciplinary collaborations (Section 4). Since REF 2014 we successfully delivered, and exceeded, our research objectives (Section 1.2.2), increasing research capacity, sustainability and vitality through:

- Strategic open-ended T&R staff appointments (31)
- Externally funded fellowships (35) and PGR training (423 awards)
- Research awards (£119.7M)
- New research infrastructure and facilities (£108.2M)
- Enhanced interdisciplinary and translational research across our 7 research themes

1.2. Delivery of research strategy from REF 2014

1.2.1. Openness, integrity and interdisciplinarity

Our researchers lead national and international research communities, developing open science initiatives – including those that foster reproducibility – and effective scientific communication with all stakeholders (see Section 4.1). This commitment to open science is reflected in the Unit's Open Research Working Group. It has over 40 members from across our community, dedicated professional support, and leadership roles recognised in our workload model. *Our researchers also embraced open research practices*: ensuring that their publications were open access, using pre-print publication of manuscripts (e.g., bioRxiv), and making data openly available to the research community, through leadership of international consortia and in-house data repositories.

We share a fundamental commitment to research integrity. All researchers undertake mandated Cardiff University research integrity training and ensure that research follows University policy on research ethics/integrity; including compliance with the Concordat to Support Research Integrity (see Institutional Statement, REF5a). School and NHS Ethics Committees provide bespoke support, with representation from the Unit on the University Open Research, Integrity and Ethics Committee.

Our research is inherently interdisciplinary. Research from all 7 research themes (see Figure 1) is supported by externally funded collaborations with researchers from different disciplines (see Section 4.2). Significant new external investment in interdisciplinary research centres increased our interdisciplinary research and impact (see Figure 3 in Section 3 and Section 3.2). Securing these investments was an explicit component of our REF 2014 research and impact strategies. Our researchers are also involved in interdisciplinary University Research Institutes, University Research Networks, and Centres of Excellence that are an integral part of the University strategy (see Institutional Statement), including the Systems Immunity and Neuroscience and Mental Health University Research Institutes.

1.2.2. REF 2014 strategic aims

Our overarching strategic aims from REF 2014 were to reinforce our position as a leading UK centre of excellence, with research strength across the scientific study of psychology, psychiatry and neuroscience. We also sought to strengthen our international reputation for basic and translational research informing understanding of major psychiatric and neurodegenerative disorders. **We had four specific research aims that are presented below.** In addition to fulfilling these four aims, our new externally funded interdisciplinary centres enabled us to advance beyond our original strategy, supporting greater research translation aligned to societal, medical and economic impacts (see Section 1.3).

1. Establish a new world-leading neuroimaging research facility. The Queen opened our new Cardiff University Brain Research Imaging Centre (CUBRIC) in 2016. CUBRIC supports cross-university interdisciplinary imaging groups undertaking imaging science, cognitive neuroscience, and clinical research. The facilities include: a 7T MRI scanner; an ultra-strong-gradient Connectome MRI scanner (the 2nd worldwide); two 3T MRI scanners; MEG; TMS; EEG; NIRS (near infrared spectroscopy); cognitive/clinical laboratories; enhanced imaging-linked computing cluster facilities; sleep laboratories; and purpose-built clinical suites and physiological monitoring to support clinical trials and integration with the NHS and industry. These facilities also enable collaborations between researchers interested in child and adolescent imaging within CUBRIC and the Cardiff University Centre for Human Developmental Science. CUBRIC supports many of our research themes: **Neuroscience, Health & Developmental Psychology and Developmental Psychiatry, Neurodegenerative Disorders, and Psychosis & Major Affective Disorders.**

The micro-structural scanning system attracted researchers from institutions in the UK (UCL, KCL, Manchester, Nottingham, Brighton and Sussex), and internationally (Australia, China, France, Germany, Netherlands, Sweden, Switzerland, USA). CUBRIC has award holders across Wellcome's portfolio: Sir Henry Wellcome Fellows (2 men, 2 women), Sir Henry Dale (2 men), Career Re-entry (1 woman), Senior Research Fellow (1 man) and an Investigator Award (1 man). It attracted an ESRC Fellow and a Sêr Cymru Fellow (both men), and international awards (NSERC, Canada; Marshall-Sherfield, USA; Rubicon Fellowship, Netherlands; Swiss National Science Foundation, Switzerland; 2 men, 2 women). CUBRIC hosts our MSc in *Neuroimaging: Methods and Applications* (87 graduated since 2014), and leads the interdisciplinary University Research Network in *Mind, Brain & Computation*.

2. Develop the translational potential of our research. We delivered this aim across our research themes (see Figure 1 and Section 1.3). For example, we received new funding for the MRC Centre for Neuropsychiatric Genetics and Genomics (henceforth MRC Centre; £2M; with 4 associated new open-ended appointments), and for the Cardiff University Neuroscience & Mental Health Research Institute (henceforth NMHRI; 2014 and 2019, £4M), a cross-institution entity bringing together behavioural and cognitive neuroscientists, behavioural geneticists, and molecular and cellular biologists. We established strength in fundamental molecular and cellular

biology by supporting a group in stem cell biology (led by *Li*). Our functional genomics and molecular biology capability was enhanced with the appointment of 4 new lecturers and senior lecturers. We enabled our leading psychiatric genomics to be translated into improved disease models and therapeutic targets through the newly established Medicines Discovery Institute (see Section 1.3.3) and a large-scale strategic partnership with Takeda Pharmaceutical Company Limited (£4M). These aim to identify novel psychiatric drug targets using genetics, and undertaking molecular, cellular and phenotypic target characterisation and modelling (see Section 3.2.4). Translational research was enhanced through a newly appointed clinical imaging chair (*Harrison*) and clinical senior lecturer (*Tallantyre*). Translation of our genetic research is a key mission of our new Cardiff UK Dementia Research Institute Centre (£23M to Cardiff), and the new Wolfson Centre for Adolescent Mental Health (£10M; see Section 3.1); both interdisciplinary centres were awarded in national competitions. The Dementia Research Institute at Cardiff, opened in 2018, is directed by *Williams* and has 5 core research programmes.

3. Link more effectively with the NHS in Wales. We strengthened links with the NHS in Wales and wider UK through two rounds of renewed Welsh Government funding for our Health and Care Research Wales (HCRW, Biomedical Research) Centres: the National Centre for Mental Health (NCMH; £9.7M) and the Brain Repair and Intracranial Neurotherapeutics (BRAIN) Unit. These investments were complemented by 5 new lecturer and senior lecturer posts, which support four of our themes: **Developmental Psychiatry, Neurodegenerative Disorders, and Psychosis & Major Affective Disorders and Neuroscience**. The NCMH expanded cross-disorder recruitment of over 20,000 participants to its cohort; delivered award-winning public engagement; developed an extensive programme of work in learning disability; embedded Welsh collaboration through including Swansea and Bangor Universities; united centres of research excellence across Wales with the NHS and social services; and attracted substantial new collaborative funding (see Section 3.2.3). We also supported NHS research and service improvement through partnering with Cardiff and Vale University Health Board to utilise electronic health records as part of our MRC mental health data pathfinder grant (£1M) with Cardiff School of Social Sciences. The BRAIN Unit (£2.7M) develops new therapies for neurological and neurodegenerative conditions including Huntington's disease, epilepsy, Parkinson's disease and multiple sclerosis. It established a dedicated NHS clinical neurosciences research facility, the Neuroscience Research Unit at the University Hospital of Wales, and a 'Good Manufacturing Practice' laboratory for processing cells for clinical application. As well as supporting career development and research training for NHS staff, our HCRW Centres transformed clinical academic training through the appointment of 17 clinical fellows (6 men, 11 women), with 10 gaining externally-funded competitive fellowships (4 men, 6 women; see Section 2.3). Our new Wolfson Centre for Adolescent Mental Health jointly funded 3 positions with the NHS.

4. Increase our funding from European sources (Horizon 2020). We secured £9.44M of new awards from European sources, including 3 ERC starter grants and 3 ERC consolidator grants. This new funding complemented ongoing projects and supported new research across our research themes. For example, our researchers led an EU project on the assessment and development of neurofeedback for treatment of psychiatric disorders (2013-2018; €5.9M), and a workstream of the EU Gene Environment Interactions FP7 project (2010-2016; £3M). We also lead the European COST Action Maximising Impact for Research of NeuroDevelopmental DisorderS (MINDDS) project (2017-2021; £600K), and were part of COSYN, a major H2020 multi-centre grant investigating the neuroscience of neurodevelopmental disorders (2016-2020; £167K; leading work package 2), and the EU FP7 Flagship Human Brain Project (2016-2018; £224K; leading medical informatics for functional gene annotation). EU infrastructure funding (£3.5M) was also key in establishing our new Medicines Discovery Institute (see Section 1.3.3).

1.3. Delivery of impact strategy from REF 2014

Our overarching REF 2014 impact strategy was founded on enabling researchers to develop the impact of their research through working more closely with users and beneficiaries. **The delivery of this overarching strategy was underpinned by the three components that are presented in the three sub-sections below.** The effectiveness with which this strategy was implemented is exemplified in our impact case studies, two of which are highlighted below. The remainder are described in the context of our contribution to society, medicine and the economy in Section 4.5.

1.3.1. Enhanced support for the delivery of research impact

Impact Champions facilitated the development of research impact across our 7 research themes in three domains: Environmental Sustainability, Health & Wellbeing, and Enterprise (see Figure 1). The broad engagement of our research community can be evidenced by the involvement of our PGR and ECR communities in impact development activities.

***A research impact journey:** Butler, a mature ESRC 1+3 PhD student and former firefighter, built on his MRes distinction to help develop a system (THINCS) to assess nontechnical skills (e.g., decision making, leadership, personal resilience) for firefighters in the UK Fire and Rescue Services. Cardiff University funded gold open access for the associated publication with his PhD supervisors, who led the research, and they secured funding for a THINCS app through an ESRC Impact Acceleration Account project (£9K). The app was developed with MyOxygen Ltd (a Bristol-based SME). The National Fire Chiefs Council (NFCC) supported the deployment of the THINCS user guide, training modules and app, which can be downloaded under license from the University to the UK Fire and Rescue Services, and aligned national and international services for a nominal fee (£1). This journey is aligned to an impact case study led by Butler's supervisors (Honey & Cohen-Hatton).*

Led by Langley, impact champions conducted a root-and-branch impact audit in 2014, which identified 17 members of academic staff pursuing research impact who then received an allocation of 100 hours within their annual workload; increasing to 20 members in 2018. Since 2014, our Performance Development Reviews generated 18 successful applications for University Research Leave of between 6 and 12 months; all included developing impact or pathways to impact from research. We also provided internal support for impact activities through our research committees. Since 2014, we funded 7 projects (ranging from £600 to £8K), and our impact champions supported 26 successful applications for ESRC Impact Acceleration Account projects (value: £3K to £25K). We secured a Knowledge Transfer Partnership (KTP) with St David's Children Society, developing innovative pathways supporting the adoption of children with complex needs (which result in these children being "hard to place"), aligned to the impact case study led by Shelton. Another KTP with Cerebra developed third-sector pathways of support and service access for children with neurodevelopmental conditions and their families.

1.3.2. Closer and stronger relationships with users and beneficiaries

Significant external funding supported translational research across our three domains of impact (see Section 1.3.3). This funding was complemented by a range of individual relationships with beneficiaries, supported in a variety of ways. For example, our ESRC Impact Acceleration projects involve partners including: Action on Postpartum Psychosis; Airbus; British Fertility Society; Government of Japan; National Fire Chiefs Council; Northamptonshire Police; NHS; Science Media Centre; Transport for Wales; Royal College of Paediatrics and Child Health; Welsh Government; WHO. Moreover, our NCMH engaged with key stakeholders and partners, including the NHS and third-sector organisations (e.g., Hafal, BipolarUK) and service users. The ESRC Impact Acceleration projects and NCMH helped shape our research priorities, enabling strong research impact.

1.3.3. Increased external funding for translational activities and research

Environmental sustainability. Our environmental psychology research group was awarded an ESRC Centre in Climate Change and Social Transformations (CAST; £5M). This interdisciplinary centre involves Cardiff, Manchester, York and East Anglia Universities, and the charity Climate Outreach. CAST works closely with industry, local/national governments, and charities to tackle climate change; and supports impact involving our **Social & Environmental Psychology** research theme.

Health & Wellbeing. The MRC Centre (led by Owen until 2019 and now by Walters) constitutes the largest research grouping within our submission, and its work aligns with the NMHRI (Section 3.2). It plays a key role in enabling translation and impact from core research themes: **Neurodegenerative Disorders, Developmental Psychiatry, Neuroscience, and Psychosis & Major Affective Disorders.** It cemented its position as a major facility for psychiatric genomics, leading international consortia in schizophrenia, bipolar disorder and dementia genetics, and

training the next generation of researchers in psychiatric genetics, bioinformatics and biostatistics, and clinical academic psychiatry. The MRC Centre attracted additional income of £105M in this REF period for research, staff and infrastructure. Figure 2 captures its translational research activities and achievements from 2014.

We established the Cardiff University Centre for Human Developmental Science. Initial University funding for laboratory refurbishment (£223K) enabled a single 1034m² building to become a hub for aligned research, impact and education. The hub includes the Wales Autism Research Centre, established with Welsh Government funding in 2010, and the Neurodevelopmental Assessment Unit (NDAU, led by *van Goozen*), established with Waterloo Foundation funding (£287K) in 2016. NDAU addresses an unmet need in children, young people and their families for rapid access to clinical and educational assessments, while creating a valuable research resource. The Centre also hosts the Fertility Studies Research Group, our Doctoral Programme in Educational Psychology, and a new MSc in Children's Psychological Disorders (first intake 2018, from which 28 students have graduated). The Centre for Human Developmental Science actively supports translational research in our **Developmental Psychiatry, Health & Developmental Psychology**, and **Cognitive Science** themes, via joint partnership with users and beneficiaries.

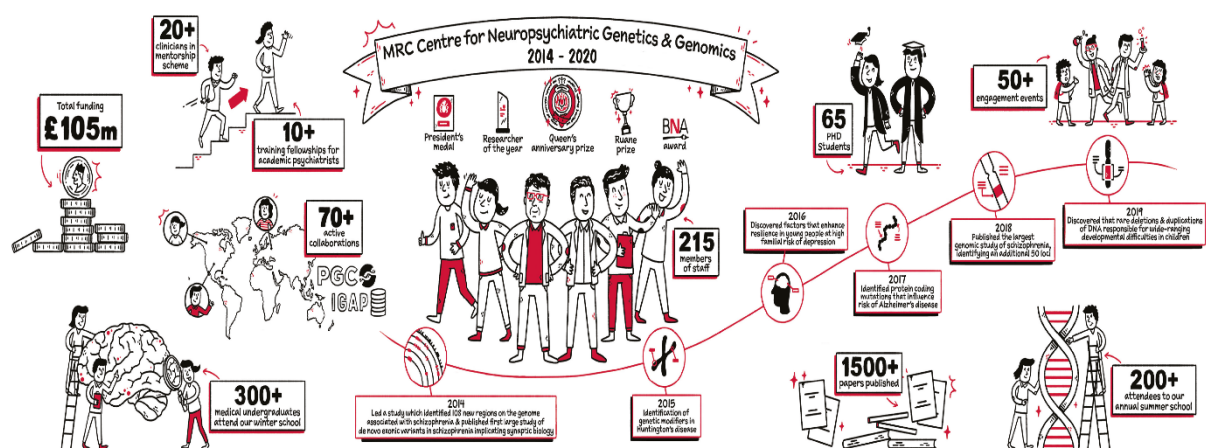


Figure 2. Achievements of the MRC Centre.

Enterprise. The Medicines Discovery Institute (MDI) was launched in 2019 (see Section 3.2). It exploits Cardiff's leading knowledge of psychiatric genomics, brain function and disease mechanisms. The MDI was established with funding from Cardiff University and Welsh Government of £14M, and £500K from the Wolfson Foundation for a Target Validation equipment suite. Welsh Government provided support for a Professorship in Translational Drug Discovery. *Ward* and co-director *Atack* (School of Biosciences) established the state-of-the-art drug discovery facility to identify drug targets and compounds for neuropsychiatric illnesses. Its mission is to identify and develop novel drugs for the treatment of mental health and neurodegeneration disorders with a significant unmet medical need. In 2020, the MDI, together with CUBRIC, secured £6.6M from Wellcome to deliver innovative new research on a novel drug to treat schizophrenia in partnership with a local CRO, Simbec-Orion. In parallel, the MRC Centre and NMHRI established a strategic partnership with Takeda Pharmaceutical Company Limited in 2018, through an initial four-year grant of £4M from the company. The partnership focusses on schizophrenia drug target identification and validation. It combines our expertise in psychiatric genetics, human stem cell and primary brain tissue neuronal models, and extensive patient cohorts, with Takeda's expertise in drug discovery as a multi-national pharmaceutical company. The MDI, and the Takeda partnership, accelerated our ability to deliver impact from our **Neurodegenerative Disorders, Neuroscience and Psychosis & Major Affective Disorders** themes.

We established the Human Factors Excellence (HuFEx) group in 2017, which provides a nexus for industrial and strategic partnerships and innovation requiring human factors expertise. It has >30 external partners from industry, government organisations, and the emergency services (see

Section 4.3), and secured grants for translational research from various sources and partners, including: Airbus (>£600k), ESRC (£507K), EPSRC (£605K), European Regional Development Fund and Welsh European Funding Office (£535K), and National Cyber Security Centre (£100k). For example, *Morgan* leads an ESRC-JST grant (£700K), delivering interdisciplinary research with Japanese Universities (e.g., Kyoto, Osaka) on the impact of artificial intelligence on society and the economy. HuFEx, and Cardiff's new Centre for Artificial Intelligence, Robotics and Human-Machine Systems (£4.6M; see Section 3.2.4), facilitates research translation involving four of our research themes: **Cognitive Science, Health & Developmental Psychology, Neuroscience, and Social & Environmental Psychology.**

1.4. An integrated research and impact strategy for the next 5 years

We want to increasingly align our research contributions to the delivery of global social, medical and economic impact. Our 6 specific aims are enabled by recent investment in infrastructure and facilities (Section 3), thereby accelerating our ability to undertake interdisciplinary research, and translational projects with external partners:

1. Integrate our child and adolescent developmental and mental health research with social sciences (schools-based research and complex interventions), genetics and neurosciences research. This aim will be pursued through the new Wolfson Centre for Adolescent Mental Health (see Section 3.1) and the Cardiff University Human Developmental Science Centre. It will include deploying our new capacity for multi-modal imaging of children to assess longitudinal brain development in typically and atypically developing children, and expanding on our genomics and functional biology capability (through the NMHRI).
2. Develop a new multidisciplinary centre focussing on health and wellbeing; including phenotyping at scale using innovative methods (e.g., wearables, online phenotyping) and electronic health records, enabling linkage to genomics data for the development of an industry-friendly platform for precision medicine research.
3. Exploit the insights from psychiatric genetics from the MRC Centre, as well as expertise in the NMHRI and the Medicines Discovery Institute, to establish a new university Centre, focussing on the translational application of genomics for drug discovery and psychiatric clinical practice.
4. Enhance our portfolio of impact-enabling collaborations with national and international partners in governmental, industrial and third-sector organisations. This will be facilitated through the: ESRC Centre for Climate Change and Social Transformations; Human Factors Excellence group; NCMH; Medicines Discovery Institute; Wolfson Centre for Adolescent Mental Health.
5. Enable our PGRs and ECRs to realise impact from their research by increasing opportunities for extended placements and secondments with new and existing external partners (e.g., those linked to HuFEx). We will also strengthen ECR involvement in impact-related activities at School, College and University levels. For example, increasing the visibility of and recognition for research impact by complementing existing recognition and rewards for research (e.g., for PhD researchers), with showcases and training, funding and recognition for impact (see also, Institutional Statement).
6. Increase the number of new industrial and strategic partnerships, and strengthen existing external partnerships (e.g., with the NHS, the Office for National Statistics, Airbus and Takeda Pharmaceutical Company Ltd) facilitating greater basic and applied research. This will be enabled through the: Human Factors Excellence group; Medicines Discovery Institute; NMHRI; Cardiff UK Dementia Research Institute Centre.

2. People

2.1. Staffing strategy and staff development

We are committed to a research culture where Equality, Diversity and Inclusion (EDI) are embedded, enabling all staff to reach their full potential. This commitment was recognised by an Athena SWAN Silver Award in 2016 to the School of Psychology, and a Bronze Award to the School of Medicine, including the Division of Psychological Medicine and Clinical Neurosciences.

2.2. Staff recruitment strategy

Our recruitment has been informed by three requirements:

1. Excellence in underpinning research and the potential for societal and economic impact, enabling vibrant research-led teaching.
2. Expertise spread across our 7 research themes.
3. A balance between senior staff and Early Career Researchers (ECRs), supporting succession and progression planning, and the sustainability and vitality of our research environment.

We focus on recruiting ECRs, including clinical academics, supporting their development into research leaders (see Section 2.3). We are also committed to diversity within our staff profile aligned to our Athena SWAN ambitions to diversify our staff and student communities. We now conduct Equality Impact Assessments for all new open-ended posts (T&R), which includes an assessment of our values and behaviours in relation to recruitment strategy. This process encompasses impact in relation to protected characteristics, including ethnicity, which led us to widen our advertising campaign to reach under-represented groups. More broadly, *Vann* is part of the Royal Society's Diversity Committee, which will report on BAME staff and students in STEM; and the BMA race equality charter has been adopted by the School of Medicine. We also give individuals the opportunity to identify in ways other than the binary categories of "male" or "female" or not to disclose gender; these numbers are small ($n < 5$), allowing individuals to be identified, and consequently will not be reported here.

Between 2014-2020 we made 31 appointments: 16 Lecturers (6 men, 10 women), 15 Senior Lecturers/Chairs (9 men, 6 women). These appointments enhanced existing strengths, and provided a basis for interdisciplinary research associated with new facilities.

Key appointments supported our underpinning research and primary areas of research impact. These were augmented by investment in a new High Performance Computing team, together with core laboratory, managerial and administrative support, across all major infrastructures (see Section 3). Our professional support staff are an integrated part of our Team Science approach across our 7 research themes. We only recruit fixed-term academic staff when there is a specific requirement (e.g., due to a secondment, parental leave, or research leave). 53 staff from our REF 2014 submission of 69.33 are included in our REF 2021 submission; of those who left, the majority retired or moved to positions at other HEIs. This level of retention, alongside our staffing and recruitment strategy and promotions procedures (see Section 2.8), creates a good balance of sustainability and vitality in our research community.

2.3. Staff development

We provide a supportive environment for individuals from the outset of their careers. The packages of start-up support for ECRs is needs-based, and includes fully-funded PhD studentships, research assistant support, and equipment. It also includes a deposit into their strategic fund (£10K), an annual budget (£2K), and free access to facilities (e.g., scanning in CUBRIC). Seedcorn funding and conference bursaries are also provided (e.g., from the NMHRI). All new academics receive a maximum of half the usual administrative and teaching duties for the first year, allowing time for them to establish their research and develop collaborative networks.

We facilitate the research of our staff throughout their careers. For all academic staff, an annual reference point is performance development review (PDR), which is a live, dynamic review process to support careers and meet our strategic vision. PDR is person-centred, with an emphasis on individual aspirations and broader school-level expectations, alongside identification of training needs and resources. Research forms a significant component of PDR, including an objective-based review of planned research and impact activities, and the progress and mentoring of PGR students. A panel of senior staff carry out PDRs, meeting before one-to-one meetings with individuals to review all of the forms (one from each academic). This ensures a consistent and supportive approach and detects those ready for promotion. In the one-to-one meetings, all aspects of an academic's role are discussed, and priorities agreed to best underpin career development. Task-specific mentoring needs are identified (e.g., grant writing, engagement activities). Areas where an individual's expertise could be shared with others is also explored.

SMART objectives are set for successful senior staff to mentor and share expertise with junior staff and vice versa. Our clinical academic staff also benefit from PDR, aligned with clinical appraisals and job planning, managed with the NHS.

PDR is part of our supportive environment, where staff share expertise and act as positive sounding boards for each other. Internal peer reviewing is another way in which all researchers support each other. This is provided for all grant and fellowship applications, with at least one specialist and at least one generalist providing detailed feedback and advice. This support is complemented by formal opportunities to pitch to peers. We encourage all staff to undertake Cardiff's Leadership Programmes (see Institutional Statement), and have systems to monitor, encourage and develop applications for promotion for all staff at appropriate career stages, particularly those who are traditionally under-represented at senior levels.

Our approach is successful: we supported 35 successful applications for externally funded fellowships (16 men, 19 women), and 2 successful UKRI Future Leader Fellowships (both men). The 35 include junior ESRC fellowships, MRC and NIHR fellowships, EU schemes and the full range of Wellcome fellowships.

We developed research capacity by expanding training of research clinicians. We prioritised clinical academics, given the nature of the research that they underpin. Since 2014 we secured 17 of the 51 available Welsh Clinical Academic Training fellowships (providing 9 years' training including PhD), and 10 further externally funded training and postdoctoral/intermediate clinical research fellowships (funded by Wellcome and MRC). We engage medical students in our research through our Winter School in Psychiatry, offering Student Selected Components (>100 since 2014) and intercalated research projects. Cardiff medical students were awarded 10 of 26 national pathfinder awards (as of 2019) from the Royal College of Psychiatrists for future academic psychiatrists. We supported 4 non-clinical ECRs through our Future Leaders in Neuroscience Research programme. The development of the future generation of mental health researchers is supported through the MRC Centre Summer School in Brain Sciences. The clinical mentorship scheme of our MRC Centre successfully mentored 30 trainees, with 8 gaining fellowships and 4 entering academic careers. In addition, our MSc programmes in Psychiatry, and Biostatistics and Bioinformatics, trained over 100 clinicians in research.

A career development journey. Peall investigates the mechanisms that underpin dystonia, a neurodevelopmental movement disorder, and how they contribute to the psychiatric phenotype in patients with dystonia. She was appointed in the inaugural round of the Welsh Clinical Academic Training (WCAT) programme as a neurology specialist trainee. Following her PhD, she undertook a clinical-research fellowship at the UMCG, Groningen, The Netherlands. She subsequently secured her first independent funding at Cardiff with an Academy of Medical Sciences Clinical Lecturer Starter Grant, and was awarded an MRC Clinician-Scientist Fellowship in 2017 (£850K). Peall established the Welsh Movement Disorders Research Network, Move Wales, which facilitated the first UK-wide dystonia network study, now recruiting at >15 sites. She was appointed as a medical advisor to The Dystonia Society UK, sits on the scientific committee of the International Movement Disorders Society, and is a lead expert in the International Myoclonus Dystonia Study Group. Peall leads the international Myoclonus Dystonia Registry, with recruitment sites across Europe, Australasia and North America. She supports the development of the next generation of clinician-scientists as the University lead for the WCAT programme, establishing a flourishing mentoring circle for clinical-academic trainees. Peall was awarded a place on the SUSTAIN programme run by the Academy of Medical Sciences.

We provide ongoing financial support for all staff to develop their research programmes. 20% of grant overheads are returned to staff, enabling the development of new lines of research, and academic staff receive an annual budget (£2K) to support their research, irrespective of grant income. Our Research Leave Scheme provides staff with one semester without teaching and administration. We also help staff to develop strong applications for submission to the University Research Leave Scheme, which provides additional funds for replacement teaching costs and research expenses. For example, in 2019, 6 staff received University Research Leave and we appointed three ECRs (*Livingston, Paine and Petrican*) via the *Darlithwyr Disglair* (Brilliant Lecturers) Scheme (see Institutional Statement). We alert all colleagues to the Staff Development

Programme at Cardiff and external training opportunities (e.g., Advance HE's Aurora leadership development initiative) and target eligible individuals as appropriate. Professional and research staff apply to the University's Cardiff Futures scheme, where *Graham* runs the research component.

2.4. Recognising, rewarding and supporting impact

The achievement of research impact is facilitated through providing mentorship, resources and recognition. Section 1.3.1 described the mentoring role of impact champions. Achieving research impact, alongside research excellence, is considered during annual PDR as a basis for promotion and salary enhancement. Ten of our senior clinical academics were granted UK national clinical excellence awards (1 platinum, 2 gold, 2 silver, 5 bronze). Cardiff University holds annual Innovation and Impact Awards in several categories: Business Innovation, International Impact, Innovation in Healthcare, Impact on Policy, and Medical Innovation. Between 2014 and 2020, our researchers won individual awards, as well as the People's Choice Award and overall winner on 2 occasions. Within the School of Medicine, our researchers won 3 STAR awards, which were launched in 2016 to recognise the achievements and contribution of staff across the School of Medicine. Our researchers also won national awards for innovation and impact (see Section 4.5.4).

Interactions between academia, industry and third sector bodies are supported through a variety of mechanisms. As noted in Section 1.3.3, establishing the Medicines Discovery Institute and the Human Factors Excellence group enabled new large-scale collaborations with industrial partners (Takeda and Airbus respectively). For example, the appointment of *Morgan* supported the development of impact through his leadership of HuFEx alongside his secondment to Airbus, where he is lead for Cyber Psychology and Human Factors, and the Airbus Accelerator in Human-Centric Cyber Security (see Section 4.3). This role includes leading a team, with Cardiff researchers and PhD students delivering new industry-identified impact outcomes (funded through Airbus Endeavour Wales). We also encouraged partnerships through the ESRC Impact Acceleration Projects (see Section 1.3.2), and PhD studentships (see Section 2.5).

2.5. Research students

We highly value the contribution of PhD students and invest considerable resources to support them. PhD students have personal desk-space throughout their studentships, a new computer with access to printers, and tailored support during the pandemic to support home working. They receive financial support to present research at conferences (£1300) and a research budget: £300 per year for participant payments, up to £5K per year for students working in the Behavioural Neuroscience Labs, and £29K of scan costs for students working in CUBRIC. Students receive additional support from their supervisors' research funds and can apply to our research committees for funding (e.g., for external training events that add value to their postgraduate experience). Our PhD students attend and present in research group meetings, organise their own seminar series and informal meetings, run an annual conference, and are encouraged and funded to present at national and international conferences to gain additional feedback and networking experience. In fact, many students secure external funding for international conferences (e.g., through learned societies, including Experimental Psychology Society, Guarantors of Brain, Harold Hyam Wingate Foundation, ISMRM) and return with prizes for their research presentations. Former PhD students now working outside of academia (e.g., Airbus; the Cabinet Office; Charitable Organizations; ONS) return annually to give current students the benefit of their experiences.

Highlighting their significant contribution to our research, PhD students are co-authors on 65 of our 270 outputs for REF 2021.

Postdoctoral researchers and fellows develop their research, teaching and PhD supervision skills with mentorship from academic staff who have significant experience developing ECR careers. Our postdoctoral researchers hold lunchtime seminars with our postgraduates to share their experiences and provide pointers on applying for postdoctoral positions. There is also extensive support from School, College, University and Doctoral Academy for fellowship applications (see Institutional Statement), which are effective in enabling success. As noted, we supported 35 successful fellowship applications, and 2 UKRI Future Leaders Fellowship applications.

2.5.1. How our research students are recruited and resourced

Undergraduate students gain an appreciation of life as a postgraduate researcher via paid research placements: The Cardiff Undergraduate Research Opportunities Programme (a University scheme) and our own Research Internship scheme both operate during the summer. Both schemes resulted in many successful applications for PhD studentships. PhD applications from candidates with diverse backgrounds and protected characteristics are encouraged through our websites, and we support part-time students by paying their fees. Our funded programmes have bespoke recruitment approaches, which results in the cross-fertilisation of best practice (including SWBio3 measures to promote inclusive recruitment). Formal recruitment involves advertising through www.findaphd.com and a broad range of University websites. After triage, the consistent interview process across PhD programmes includes brief research presentations followed by questions about the research, PhD programmes (see next paragraph), projects and careers.

We have a broad portfolio of funding to support postgraduate research across our 7 research themes. We secured UKRI studentships: BBSRC (4; including CASE studentships, 2014-2019), EPSRC (9), ESRC (18; including 2 interdisciplinary), MRC (2), and clinical training (PhD) fellowships from the EU, MRC and Wellcome (7). We also secured studentships from charities: Leverhulme and Waterloo Foundation (4), and Hodge (5); complemented by studentships associated with the MRC Centre (13), NMHRI 50% studentships (11), and a Wellcome Strategic Grant (DEFINE: 3; see Section 3.1). *Aggleton* leads the Cardiff Wellcome Trust Integrative Neuroscience Programme (£5.4M; 30 students from 2014-2019), and *Owen* leads MRC GW4 BioMed (£6.6M; 6 yearly cohorts from 2016). *Peall* leads the Welsh Clinical Academic Training programme. Our researchers lead both the Psychology pathway for the University-led ESRC Wales DTP (£15M; 6 yearly cohorts from 2017) as we did for the previous ESRC DTC (£12.5M; 6 yearly cohorts from 2011), and two large-scale cross-institutional doctoral training programmes: BBSRC SWBio2 (£8.0M; 5 yearly cohorts from 2015) and SWBio3 (£18.5M; renewed funding for 5 yearly cohorts from 2019). Involvement in these programmes shows that our research and research training is valued and coheres with UKRI strategy. Externally funded studentships on these major programmes are complemented by 4 matched institutional studentships, and 79 fully funded studentships from within our own budgetary envelope. We host Welsh Government-funded Doctoral Programmes in Educational Psychology and Clinical Psychology.

2.5.2. How we support the development of our PGR students

Our PGR students are central to our mission, and we are committed to supporting their transition to fulfilling careers. While there is variation in training associated with the requirements of different funders, Cardiff University mandates that all of our PGR students have 6-monthly and annual monitoring, which includes a bespoke analysis of their training needs, and all have at least two academic supervisors. Mock vivas build skills designed to ensure a positive award outcome (see Institutional Statement). In addition to project-specific support within their research groups, all PGR students have access to a broad range of training opportunities and events throughout the academic year, run by the Cardiff Doctoral Academy. The success of our approach to training is evident in our high completion rates (e.g., >90% of our PhD students submit within 4 years), and our students' contributions to our REF 2021 outputs (noted above). The value of our training is evident from the range of careers chosen by our PhD students, which include: academic careers (e.g. UKRI PDRA positions, Wellcome Fellowships, and lectureships), working in industry (e.g. Airbus), and the public sector (e.g. policy-making in the Cabinet Office). For example, *Cohen-Hatton* is now a Cardiff University Fellow who co-produces research with us and helps to supervise our PhD students. Since her PhD, she became one of the most senior female firefighters in the UK Fire and Rescue Service, as Chief Fire Officer of West Sussex Fire and Rescue Service. All graduates from our professional doctorates secured positions as Educational Psychologists or Clinical Psychologists.

Between 2014-2020, a total of 423 PGR students graduated: 253 PhDs (89 men and 164 women); 96 Professional Doctorates in Clinical Psychology (20 men, 76 women); and 74 Professional Doctorates in Educational Psychology (8 men, 66 women).

2.6. How we embed equality, diversity and inclusion (EDI)

Equality, diversity and inclusion are central values within our environment. Staff share ownership of championing equality, diversity and human rights as core tenets of our working environment. Central to this approach is our vision to promote fairness, inclusivity and diversity at all levels, and to provide a supportive culture for all (see Section 2.7). Over 50 staff and students volunteered to promote and develop EDI activities. Working together, EDI committees and task groups requested, collated and listened to the views of our staff and students. They then created and enacted new policies, procedures, activities and actions, aiming to build and embed a working culture characterised by inclusivity and equality of opportunity for all. The work of EDI Committees ensured that we: are a family friendly workplace (e.g., parental buddy scheme, baby changing facilities); protect wellbeing in staff and students (our internally staffed Wellbeing Team provides confidential advice and promotes wellbeing through regular events); support staff and student career development (e.g., helping to establish the new ECRs Forum, the Maintaining Women in Science group, and an annual academic promotion review panel); and simplify everyday working life by improving communications (e.g., embedded comms team, comms screens in buildings highlighting EDI and wellbeing initiatives). The most recent University Staff Survey indicated that 90% staff felt respected by their colleagues, and that their work was interesting to them. Two examples of where we improved our local culture during this REF period are: recruitment and induction processes.

Recruitment. Every advertised post notes our Athena SWAN awards, the University's EDI policy and our work-life balance commitments. We also follow University policy for fair recruitment for all posts (see Institutional Statement). Application packs contain equal opportunities monitoring forms, with all new vacancies considered for flexible working. For academic posts, we seek a diverse applicant pool by advertising to diverse audiences, alerting peers, and convening search teams (of men and women) to systematically identify and approach candidates. We now work in collaboration with the Race Equality Supervisory Panel and use gender de-coding software across all applicable posts. We have parity in applications from men and women, but fewer applications from ethnic minorities. There was no evidence of bias in appointments based on gender during the REF 2021 period. Shortlisting and interview panels are always constructed with equality and diversity in mind. We consult candidates about interview dates to allow those with caring responsibilities to attend. Presentations are attended by a cross-section of staff who provide feedback, which is summarised for the interview panel by two independent members of staff. We now include undergraduate students to provide feedback on teaching. All panel members complete mandatory University EDI and unconscious bias training, including training in work-life balance.

Induction. We prioritise ensuring that those starting their careers enter a supportive environment, including the provision of start-up packages described earlier. Induction includes a one-to-one buddy system, 'meet the teams', FAQs, University and School structure diagrams, explanations of School systems, an induction checklist, information about career development, flexible working and University support networks (e.g., Black Minority Ethnic +; University Carers). Members of senior management and HR Advisors meet all new appointees to discuss the University's Positive Working Environment, which has gender equality and protected characteristics as core elements.

We are also committed to diversity in external speakers, with the aim of providing appropriate career roles models for staff and students. We strongly encourage staff to invite diverse speakers to all of our seminar series and aim to represent a range of career stages. Speakers are asked to be available before their talks to meet with staff and students. Our three-year data indicate presenter balance by career stage and men/women (but not yet for other protected characteristics, e.g., race). Audience data show similar numbers of staff and postgraduates, with a small number of undergraduates.

2.7. How we enable the engagement of all staff and students with research

We enable flexible and remote working, and support people returning to work. All staff and line managers are informed about the University's flexible working policy, our guidelines, and how to apply for different flexible working arrangements including: part-time; compressed hours; term-time working; staggered hours; and job share arrangements. The fact that these processes were

embedded and well supported left us well placed to respond effectively to Covid-19. An HR advisor helps tailor new arrangements to personal circumstances, and staff can undertake a 12-week trial to gauge its suitability. On returning to work (e.g., following parental leave or ill health), line managers update staff on changes during their absence, and discuss structured re-integration into work. We have private rooms for expressing and storing milk, and the University nursery is available for staff and students throughout the year. As part of the University Positive Working Environment scheme, there is a salary sacrifice childcare voucher system. We set aside funds for costs associated with leave, including replacement teaching and administrative support, which can extend into post-leave periods. Staff returning from parental leave or ill health receive at least 50% reductions in teaching and administrative workloads for at least the leave duration (up to one year). Support is also provided to maintain productive research during leave, such as funding research assistants. A senior member of staff (e.g., the Head of School) consults staff before and on return from parental leave to discuss their needs.

We recognise and address difficulties faced by (part-time) staff. For example, caring commitments are acute in early morning, mid-afternoon and evening, and we therefore have a policy that all meetings occur between 10:00 and 15:30. Attendance at these meetings remained above 85% with no evidence of a gender difference. We also attempt not to arrange meetings in school holidays (including half-term) within the constraints of the academic calendar. Nearly all seminars are scheduled between 12:00 and 15:00. Research groups hold lunchtime seminars in which postgraduate students participate. Most formal and informal social gatherings were switched from 17:00 to fall between 10:00 and 15.30.

Our policies for PhD students and postdoctoral researchers are designed to help them maintain research careers, and achieve the same successes (e.g., publishing) as they would have done without parental leave; and our policies also facilitate unbiased recruitment (e.g., by ensuring that parental leave does not hamper delivery of funded research projects). During parental leave, PhD students retain access to University email, and administrators have informal contact with students as well via telephone or email. They can also apply to the research committee for a £300 travel bursary to support childcare costs associated with conference attendance.

Supporting the careers of carers. *Powell was one of our PhD students who became a research associate, and was concerned that starting a family could have a significant impact on her career development. She became the first research associate to benefit from a new formal scheme that provided a 6-month extension to her fixed-term contract to compensate for maternity leave following the birth of her son. Powell now has an independent 3-year fellowship from Health and Care Research Wales.*

2.8. Our promotion procedures take all activities into account

Promotions are primarily based on excellence in research or teaching or innovation, civic mission and international. Our researchers achieve promotion with diverse portfolios, sometimes reflecting individual circumstances that may have constrained them. The University Director of Leadership and Staff Development runs promotion workshops to inform applications to the University annual round of promotions (see Institutional Statement), supported by university committees (including men and women). We support all staff in their applications for promotion, with the PDR process enabling us to identify individuals whose performance and contributions suggest suitability for promotion. The staff member is advised to discuss promotion with members of the Promotion Panel (e.g., Head of School), who have completed unconscious bias training, and they are allocated a promotion mentor. 15 staff have been promoted to personal chair (9 men and 6 women).

2.9. Supporting staff and PGR wellbeing

We are committed to the delivery of a positive staff experience matching the student experience. Our biennial staff survey monitors progress to this target, with a University ambition to be in the top quartile amongst our (Russell Group) peers for our staff recommending Cardiff University as a great place to work. We have established a Wellbeing team. They arrange weekly activities (from exercise to mindfulness), trained staff members in mental health first aid, and volunteer as wellbeing advisors. Close links with student and staff support services enable rapid signposting of advice. This information is shared with new staff via an induction pack and is regularly

communicated to existing staff. These arrangements, supplemented by online formal and informal research group meetings in response to Covid-19, enabled us to support our researchers and complement the wellbeing days organised by Cardiff during the pandemic.

2.10. Construction of our REF 2021 submission

Our submission was driven by the ambition to represent the full breadth of our research and impact. Recognising individual circumstances, we undertook an assessment of outputs underpinned by principles enshrined in the San Francisco Declaration on Research Assessment (DORA), to which Cardiff University is a signatory (see Institutional Statement). Outputs were assigned to individuals (when co-authored with colleagues) by Directors of Research and Heads of School. These decisions were informed by reviews from a gender-balanced group of reviewers. All individuals received bespoke REF EDI training, and were informed about the benchmarks for evaluation. The development of impact case studies was formally assessed at School, College and University levels (including external assessment). Decisions about research staff independence were based on the University's REF 2021 Code of Practice (see Institutional Statement), and made by the Directors of Research and Heads of School, who received additional REF EDI training and were supported by a designated REF Panel Link Member of the REF Committee.

3. Income, infrastructure and facilities

3.1. Research income and income generation strategy

Our researchers have access to state-of-the-art infrastructure and facilities that provide unique opportunities for complementary studies across methodologies, and for interdisciplinary and multidisciplinary collaborations involving a variety of stakeholders. Figure 3 provides an overview of our infrastructure, facilities and associated investments, and illustrates how these support our underpinning science and research impact across Environmental Sustainability, Health & Wellbeing, and Enterprise.

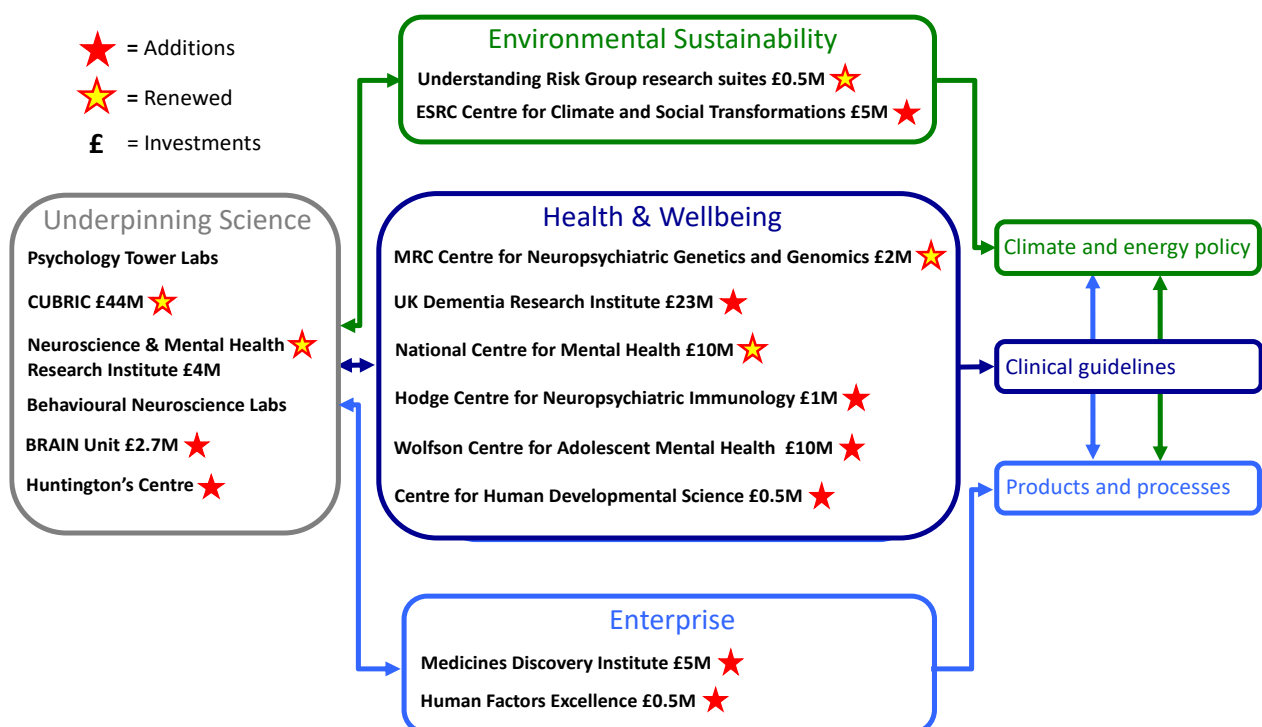


Figure 3. Infrastructure and facilities supporting interactive pathways to impact.

Support for research and impact activities is available to all researchers from PGRs to Professors, and is delivered at multiple levels across the institution. At school level, there are pitch-to-peer events, internal peer reviewing of grants, PDRs, and annual research away days. At College level, ECRs can participate in internal research-funding panels (e.g., for the £7M Wellcome Trust ISSF at Cardiff). At University level, there are regular courses and events run by the Graduate Academy and our Research and Innovation Services (e.g., dedicated support for fellowship applications;

see Institutional Statement). We identify specific funding calls for researchers, and use bespoke automated funding information through emails (e.g., research fingerprinting). School, College and University level support exists for generating bids and preparing for interviews, often entailing iterative reviewing and multiple mock interviews (e.g., for Wellcome fellowship applications). These activities are advertised widely (e.g., through emails and College Bulletins), with specific needs being identified through PGR monitoring, discussions with the mentors assigned to every ECR, and through the staff annual PDR process. Two large-scale examples of the success of this strategy are the Wolfson Centre for Adolescent Mental Health and the UK Dementia Research Institute.

The £10M Wolfson Centre for Adolescent Mental Health was funded competitively in 2019. It is led by *Rice* and *Collishaw*. Its mission is to reduce anxiety and depression in young people through partnerships with the Welsh Government, the NHS and the Office for National Statistics. The centre is truly interdisciplinary, bringing together experts in child and adolescent psychiatry, genetics, social science, clinical records research and public health to illuminate adolescent mental health and develop novel preventative approaches and interventions. It supports research and research impact in three of our themes: **Health & Developmental Psychology**, **Developmental Psychiatry**, and **Psychosis & Major Affective Disorders**.

The UK Dementia Research Institute, established in 2017, combines expertise in biomedical and translational research using novel technologies and interdisciplinary approaches to build knowledge leading to new treatments for neurodegenerative conditions. Cardiff is one of seven centres: Cambridge, Edinburgh, Imperial College London, King's College London, Care Research & Technology at Imperial, and UCL. The Cardiff centre is led by *Williams* and aims to bridge the gap in knowledge between how the healthy brain functions and what leads to its degeneration. Research is developing better models of disease and translating research findings into new diagnostics, treatments, and, in the longer term, cures. The Cardiff centre received £23M funding for five core research programmes, linking particularly with colleagues in immunological research, and supporting research and the development of impact from our **Neurodegenerative Disorders** and **Neuroscience** themes.

Our mean research awards per annum increased from £8.3M (REF 2014) to £17.1M (REF 2021; total = £119.7M). The largest source of funding was UKRI (£48.3M), with the next being UK charities (open competition; £31.3M) to which Wellcome made the largest contribution. Thus £79.6M of our awards were obtained through highly selective, peer-reviewed competitions.

This funding supported research across our 7 research themes and included large-scale interdisciplinary projects and strategic grants in addition to those noted in Section 3.2. For example, the MRC supported research characterising brain network differences during scene perception and memory in APOE-e4 carriers, using multi-modal imaging with the Avon Longitudinal Study of Parents and Children (£1.7M; led by *Graham*). Our researchers also received two strategic grants from Wellcome: one to integrate basic and clinical neuroscience to explore mental disorders (DEFINE: £5.2M; led by *Owen*); and the other to undertake a multi-modal assessment of coupling in healthy and diseased brains (£4.9M, led by *D. Jones*). We next highlight how our infrastructure and facilities enable our research and impact, including interdisciplinary research with local, national and international academic and non-academic partners (see also, Sections 4.2 and 4.3).

3.2. Research infrastructure and facilities

Our 7 research themes are supported by extensive shared infrastructure and facilities, allowing the delivery of our REF 2014 research and impact strategies (see Sections 1.2 and 1.3) and supporting the delivery of the corresponding REF 2021 strategies (see Section 1.4).

3.2.1. Supporting our underpinning science

The **Psychology Tower Labs** include extensive bespoke space for research on cognition, emotion, perception, and social psychology, supported by a broad range of funders (e.g., ESRC, EU, EPSRC, Leverhulme Trust, MRC). The Psychology Tower is also home to our Doctoral Programme in Clinical Psychology. **CUBRIC** has state-of-the-art scanning technologies and

facilities for cognitive and clinical imaging (see Section 1.2.2). The total investment in CUBRIC was £44M, with £27M coming from external sources (EPSRC, MRC, Wellcome Trust, Wolfson, and Welsh Government). New funding included awards to undertake imaging genomics, neurodevelopmental, and psychiatric and clinical neuroscience imaging projects. For example, in addition to the MRC and Wellcome grants noted above, our researchers are also involved in a cross-institutional MRC-funded project to map neurodevelopmental trajectories for adult psychiatric disorders (total value: £2.2M).

The **Neurosciences & Mental Health Research Institute** has extensive research space in the Hadyn Ellis Building, and provides a base for interdisciplinary researchers who conduct basic and translational work. The Hadyn Ellis Building is close to CUBRIC, Cardiff's Experimental MRI Centre (EMRIC) for animal imaging, and the Behavioural Neuroscience Labs. Dedicated laboratory space within the Hadyn Ellis Building now includes enhanced provision for testing children and patients with neurological and psychiatric disorders. The institute is also home to the Wellcome Trust PhD programme in Integrative Neuroscience (with 87 students graduating since 2014). The **Behavioural Neuroscience Labs**, including the Henry Wellcome Laboratories for Behavioural, Transgenic, and Molecular Neuroscience, support the use of extensive state-of-the-art techniques to investigate learning and memory processes in non-human animals at the behavioural, molecular, cellular, neural and genetic levels. Research is supported by funding from the BBSRC and MRC (£1.6M), the Wellcome Trust and other charities (£4.2M). These labs, together with Cardiff's expertise, were a vital draw for a successful application for a Welsh Government Sêr Cymru Rising Star Fellow (O'Neill; £665K).

As noted in Section 1, the **BRAIN Unit** develops new therapies for brain diseases, and complements the **Huntington's Disease Centre**, which brings together researchers and clinicians from across South Wales, and is a leading UK centre for research into Huntington's Disease. It also provides specialist advice and care for people who have or are at risk of developing Huntington's Disease, and their families and carers.

3.2.2. Supporting research and impact in Environmental Sustainability

The **Understanding Risk Group** occupies newly refurbished laboratory and office space within the Psychology Tower, providing a base for its interdisciplinary research. The research informs government policy across climate change risk, energy system change, energy practices and everyday life, industrial policy and the circular economy, greenhouse gas removal, sustainable housing and environmental protection. The group, led by Pidgeon, attracted £3.1M from the EPSRC, ESRC, EU, Leverhulme Trust and NERC, and an addition £600K from other sources (including the Welsh European Funding Office). Our new **ESRC Centre for Climate Change and Social Transformations** (£5M) works closely with industry, local and national governments, and charities to tackle climate change. This will be a flagship Centre in the new sbarc | spark building (Social Science Research Park) on Cardiff's £300M Innovation Campus (see Institutional Statement), which aims to provide a nexus for interdisciplinary social sciences research, including with external partners.

3.2.3. Supporting our research and research impact in Health & Wellbeing

The **MRC Centre** received renewed core funding (£2M) for 5 years in 2014 and is located within the Hadyn Ellis Building. Its principal achievements are summarised in Figure 2 in Section 1.3.3. Research focusses on identifying genetic risk factors for disorders including schizophrenia, bipolar disorder, Alzheimer's disease and attention deficit hyperactivity disorder. For example, researchers pioneered studies of the genetic overlap between disorders, with important implications for the way we diagnose mental illness. They also identified novel potential targets for new treatments. The **UK Dementia Research Institute** at Cardiff occupies bespoke space within the Hadyn Ellis Building, with two Momentum Fellows and two Sêr Cymru Rising Stars leading externally funded independent research groups within the institute. The **National Centre for Mental Health** is also located in the Hadyn Ellis Building, and received £9.75M through Health and Care Research Wales (Figure 4 in Section 4.6 shows its contribution to our stakeholder and public engagement strategy). Welsh NHS R&D funding provided £0.5M for clinical studies funded through the Research for Patient and Public Benefit scheme. The **Hodge Centre for Neuropsychiatric Immunology** within the NMHRI has an interdisciplinary remit to bring together

neuroscience and immunology expertise to understand mental health disorders such as Alzheimer's disease and schizophrenia. Recent discoveries, many led by our researchers, provide new ways of understanding the causes of these conditions, and open up the potential to develop novel treatments for them. Our new **Wolfson Centre for Adolescent Mental Health** is another interdisciplinary research centre (see Section 3.1), and complements the Cardiff University **Centre for Human Developmental Science**, with purpose-built laboratories funded by internal and external investment (see Section 1.3.3).

3.2.4. Supporting our research and research impact involving Enterprise

The **Medicines Discovery Institute** attracted research income of £14.6M. The Institute also played a key role in collaborating with *L. Jones*, to secure funding from a spin-out (LoQus23 Therapeutics) financed by the Dementia Discovery Fund. This diversification into non-academic funding will be extended to include commercialisation of assets (e.g., an AMPA receptor drug for the treatment of schizophrenia) as well as the formation of additional spin-out companies. The Institute aims to establish itself as a hub for innovative drug discovery creating academically funded projects and spin-out companies, but also training the next generation of drug discovery scientists. The institute complements our strategic alliance with Takeda Pharmaceuticals Company Ltd. As already noted, our **Human Factors Excellence** researchers contribute to the new Cardiff University Centre for AI, Robotics, and Human Machine Systems (£4.6M), an interdisciplinary collaboration between our human factors researchers, researchers within the College of Physical Sciences and Engineering, and external partners. It created enhanced and new academic research capacity, strengthening critical masses, and aims to deliver transformative research through working with industry and the public sector. The associated Simulation Lab occupies extensive ground floor space in the Psychology Tower Labs, and includes a 6mx6m 360° immersive dome with a full surround screen, a transport simulator with autonomous capabilities, and command and control provision to support research with our partners, including the emergency services (e.g., UK Fire and Rescue Services) and industry (e.g., Airbus).

3.3. Research and research impact is supported by core Cardiff University infrastructure and facilities

Core infrastructure and facilities that supported REF 2014 and REF 2021 research and impact strategies include: dedicated postgraduate support (e.g., Doctoral Academy); administrative support (e.g., Research and Innovation Services); support for the development of laboratories (including CUBRIC, CUCHDS, Medicines Discovery Institute, and the Understanding Risk Group); and research space within the Hadyn Ellis Building (including the DRI and NMHRI); Advanced Research Computing provides high-performance computing and e-research services for researchers; Central Biotechnology Services provides a central ISO 9001 and 17025 accredited "core" facility (see Institutional Statement).

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

Our researchers have local, national and international collaborations, involving academic and non-academic partners. Our 9 case studies, developed via external partnership working, provide examples of how our published research makes valuable contributions to society, medicine and the economy. These complement a wide range of public engagement activities, with a focus on patient, family and carer participation, as well as many other non-academic collaborations with industrial and other sectors (e.g., charities and the NHS).

4.1. Contribution to the research base

Research conducted across our 7 research themes influenced the disciplines of psychology, psychiatry and neuroscience (see Sections 4.4, 4.5 and 4.7), as well as how scientific discovery in our discipline is pursued and communicated. We highlight our approach to the latter below:

4.1.1. Underpinning open and reproducible research practices

Our researchers lead worldwide initiatives promoting open, reproducible research practices, aligned to our ambition to facilitate ongoing innovation in this domain (see Section 1.2.1). Our Open Research Working Group has over 40 members and is led by *Chambers* and *C. Morey*. We created the *Registered Reports* article type, which aims to prevent publication bias and reporting

bias by undertaking peer-review and output acceptance before authors conduct their research. Since 2014, Registered Reports are now included in over 200 journals. We played a leading role in developing the Transparency and Openness Promotion guidelines, now adopted by over 5000 journals and organisations, as well as the Peer Reviewers' Openness Initiative, the Accountable Replications Policy at the Royal Society, the UK Network of Open Research Working Groups, and the recently established UK Reproducibility Network. Our researchers teach open research practices and shape external policies and practices. For example, *Chambers* chairs the Registered Reports committee supported by the Centre for Open Science and serves on the Credibility Advisory Board of the British Neuroscience Association.

4.1.2. Field-leading statistical analysis

The development of Bayesian statistical analysis techniques, pioneered by *R. Morey* and his international collaborators, is now built into the IBM statistical software package SPSS 25. This package is used across the world, an approach made possible because Morey publishes his code and procedures transparently (and IBM was able to verify and utilise his code in their work). In addition, his code is used in two additional open-source statistical packages, JASP and jamovi, employed by researchers across the world.

4.1.3. Responsible communication of scientific discoveries

Our leadership in open science, reproducibility, and statistical analysis is complemented by our influence on how science and health findings are communicated responsibly in the media. We conducted ESRC-funded interdisciplinary research, with the School of Journalism, Media and Culture, on exaggerations versus cautious communication in University and Journal press offices and the national and international media. This research, led by *Sumner*, influenced how findings are communicated by press officers and the approach taken to their training (e.g., revised STEMPRA guidelines). It also resulted in the Academy of Medical Sciences making 4 recommendations concerning exaggeration of health news to: the Science Media Centre, STEMPRA, UK Research & Innovation funders, and to the Research Excellence Framework. The work influenced the development of new science media centres and health communication networks across the world (e.g., Germany, the Netherlands, New Zealand).

4.2. Local, national and international collaborations

4.2.1. Local collaborations

Collaboration between our researchers across the University is fostered by shared research interests, infrastructure and facilities (see Figure 3 in Section 3.1). We previously mentioned the externally funded interdisciplinary centres that our researchers lead (see Section 3.2). The College of Biomedical and Life Sciences further promotes interdisciplinary collaboration via its major research themes, one of which is Mind, Brain and Neuroscience (with *Singh* as Theme Lead). The University encourages further collaboration across Colleges via its University Research Institutes and Networks, which includes our leadership of the NMHRI and the University Research Network in Mind, Brain and Computation. The Institute provides an axis for strategic joint appointments between Psychology, Medicine and Biosciences. Significant interdisciplinary research was also undertaken with the Schools of Architecture, Computer Science and Informatics, Engineering, Geography and Planning, Journalism, Media and Culture, Optometry and Vision Sciences, Pharmacy and Pharmaceutical Sciences, Physics and Astronomy, and Social Sciences.

Our new Joint Research Office with Cardiff and Vale University Health Board (£0.75M) streamlined research governance and contractual arrangements enabling increased engagement with clinicians. We host 51 CAT-C honorary research NHS staff (28 men, 23 women), with access to libraries, research infrastructure and laboratory space. They make important contributions to our environment: training early career researchers, working alongside our researchers in clinical trials, and supporting the recruitment and engagement work of our NCMH. 5 NHS consultants and clinicians were mentored to NHS research awards, allowing protected research time (1-2 days per week) for up to 3 years. NHS clinicians making substantive research contributions receive Honorary Professor status. These include *Hamandi* (Consultant Neurologist), who fosters clinical

neuroimaging research in CUBRIC, and *Jolles* (Consultant Immunologist), who received NHS research funding with our researchers for interdisciplinary research in psychiatric immunology.

4.2.2. National collaborations

The GW4 Alliance of universities (Cardiff, Bath, Bristol and Exeter) supports extensive collaboration within the region (including 4 UKRI innovative doctoral training programmes). We also collaborate with many other institutions (e.g., Aberystwyth, Bangor, Bath, Bristol, Cambridge, Edinburgh, Exeter, Francis Crick Institute, Glasgow, Imperial College, Kings College, Manchester, Nottingham, Oxford, Queen Mary, Swansea, UCL, UEA, and York). For example, as already mentioned, *Williams* leads the Cardiff UK Dementia Research Institute Centre, and *Owen* co-led the Neurodevelopmental Group for the Wellcome Trust UK10K initiative (one of the first large-scale genetic sequencing studies of 10,000 UK participants). Our researchers with CU researchers in social sciences were also one of seven centres awarded funding under the MRC mental health data pathfinder programme (£1M; 2018-2020). The College of Biomedical and Life Sciences supported this programme of work by establishing a lectureship focused on integration of genetic, clinical and electronic health data. The pathfinder involves national collaboration via joint work packages delivered through other pathfinder projects (with Cambridge University, King's College London, Oxford University and Swansea University). The ESRC Centre of Climate Change and Social Transformations is a national interdisciplinary collaboration, which works closely with industry, local and national governments, and charities to tackle climate change. The centre builds on the success of The Climate Change Consortium of Wales (C3W), led in Cardiff by *Pidgeon*, and involving a cross-HEI collaboration with Aberystwyth, Bangor, and Swansea Universities. It was funded by the Welsh Government through the Higher Education Funding Council for Wales (£4M). Our researchers also lead Cardiff's involvement in two multi-centre psychosis studies: MRC SPRING (£4M) with Manchester and Nottingham; and MRC STRATA (£5M) with Edinburgh, King's, and Manchester.

4.2.3. International collaborations

Our researchers benefit from strategic partnerships that Cardiff University developed with universities in China and Europe (see Institutional Statement). They also have collaborations including the Broad Institute, MIT and Harvard; Mount Sinai; Karolinska Institute; Universities of North Carolina; Granada; Toronto; Trinity College Dublin; Aarhus; Oslo; Vrije Universiteit; Amsterdam; and institutions in many other countries (e.g., Brazil, India, Japan and Zambia). For example, *Pidgeon* co-led the risk perception theme of the US NSF's Centre for Nanotechnology in Society co-ordinated by UC Santa Barbara from 2006-2015. *van Goozen* worked with Leiden University on two large Dutch Science Foundation (NWO) grants (combined value €1.3M) on biomarkers of aggression in children, and early interventions to reduce aggression in infants. *O'Donovan* and *Walters* co-chair the Psychiatric Genomics Consortium (PGC) Schizophrenia Group, the largest consortium in psychiatry with other 160 international collaborating PIs from 32 countries. *Holmans* co-leads the Systems Biology group within the same consortium. *Smith* was a partner in FLAGSHIP, a 53-month, part EU-funded project (€10M), focusing on improvement of safety, environmental friendliness and competitiveness of European maritime transport. We also led two EU-FP7 Programmes: BRAINTRAIN (*Linden*, €5.9M), a study exploring the therapeutic use of brain imaging; and REPAIR-HD (*Rosser*, €6M), a preclinical study to develop human stem cells for transplantation in Huntington's Disease; co-led three EU-FP7 work packages (*O'Donovan*, *Owen*, *Holmans*, €3.7M; see Section 1.2.2).

4.3. Industrial and strategic partnerships

Our researchers have established strategic partnerships. The Medicines Discovery Institute and HuFEx provide an important basis for the development of industrial and strategic partnerships (see Section 1.3.3). Significant successes include a drug discovery partnership established by our researchers with Takeda Pharmaceuticals Company Ltd, who made an initial investment of £4M over four years, and has more recently acquired Shire plc, another pharmaceutical company, in a £46 billion acquisition. This significant expansion provides further opportunities for collaboration. HuFEx has >30 external partners from industry (e.g., Airbus, Aston Martin Lagonda, Atkins, BAE Systems, BMT Defence, Environment Resource Management, GDUK QinetiQ, Thales), government organisations (e.g., GCHQ, National Cyber Security Centre, Welsh Government),

emergency services (e.g., National Fire Chiefs Council, NHS, Police UK), and charities (e.g., AgeUK, Guide Dogs). *Morgan*, HuFEx Director, secured a 3-5-year 80% FTE secondment with Airbus in the area of Human Factors and Cyber Security (see Section 1.3). The Medicines Discovery Institute and HuFEx provide the foundation for our translation research ambitions for the foreseeable future.

4.4. Contributions to the sustainability of our disciplines

A core part of our mission is to train the next generation of increasingly interdisciplinary scientists, and to equip them for exciting careers as future leaders within and outside academia. Our PGR students are supported by a broad range of innovative training, and we graduated 423 PGR students in the period (see Section 2.5). We also lead the provision of other types of formal and informal training, including the MRC-funded (£1M) UK MEG consortium, which seeks to build multi-site clinical research capacity in magnetoencephalography; and MSc courses in *Neuroimaging: Methods and Applications*, *Psychiatry*, *Biostatistics and Bioinformatics*; and *Children's Psychological Disorders*. Our researchers deliver Summer Schools in Brain Sciences (attracting >150 UK and international ECRs) and the Winter School in Psychiatry (attracting >350 students from across the UK). This provision provides an effective pipeline from undergraduate to future leader, enabling us to attract and expand the number of research fellows we host.

Leadership of international conferences: *Aggleton*, British Neuroscience Association; *Dwyer*, Associative Learning Symposium; *Metzler-Baddeley*, UK Dementia MRI conference; *I. Jones*, Chair of the International Congress of the Royal College of Psychiatrists; *Owen*, Genomics of Brain Disorders, Wellcome Genome Campus; *D. Jones*, International Society for Magnetic Resonance in Medicine (ISMRM); *Wilkinson*, European Meeting on Glial Cells in Health and Disease; *Hall*, Cold Spring Harbour Schizophrenia Symposium.

Contributions in leadership positions and on research boards: *Bisson*, Director Health and Care Research Wales; *Owen*, Mental Health Research UK, Trustee and Chair of Grants Committee, and Council (elected) Academy of Medical Sciences; *Williams*, Chief Scientific Adviser in Wales. *Graham*, Deputy Chair, MRC Non-Clinical Training and Career Development Panel, and MRC Council; *Hall* (Deputy Chair), *O'Donovan*, *Rosser*, MRC Neuroscience and Mental Health Board; *Harrison*, Wellcome training fellowships board.

Cardiff University signing the San Francisco Declaration on Research Assessment (DORA) is reflected in our researchers accepting invitations to be Editors or on the Editorial Boards for >30 international peer-reviewed journals from across the impact factor spectrum. They also served on funding and strategic committees for national and international funding bodies (e.g., Autistica, ESRC, European Research Council, NERC, the Norwegian Research Council, the Wellcome Trust), and in leadership roles for many learned societies and charities (Academy of Medical Sciences, Alzheimer's Dementia Charity, BRACE, Climate Outreach, European Society for Human Reproduction and Embryology, Federation of European Neuroscience Societies, Learned Society of Wales, Royal Society).

4.5. Contributions to the economy and society

Our 9 impact case studies illustrate how our research leverages public value. Below we provide further information about broader contributions to society, medicine and the economy that are aligned with these case studies, and other facets of our research impact.

4.5.1. Environmental Sustainability

We influence policy and practice through participation in Science Advisory Committees (e.g., Department for Business, Energy and Industrial Strategy; Department of Energy and Climate Change; Department for Environment, Food and Rural Affairs; Government Office of Science; the Science Council of the UK Department for Transport). These influences reflect the research conducted by *Demski* and *Pidgeon*, which forms the basis of the impact case study led by *Pidgeon*. Our researchers also provided expert evidence to Parliamentary Select Committees and UK Ministers, and presented research to policy audiences (business, third sector, Westminster, Scottish and Welsh Governments,), including our research about single-use packaging that underpins the impact case study led by *Poortinga*.

4.5.2. Health & Wellbeing

Our researchers contribute to health policy, guidelines and advisory committees. They contribute to University Health Boards (R&D Chair, *Bisson*); the Welsh and UK Governments (CAMHS review: *Thapar*; DoH genetics consultation, *Owen, Walters*); the National Institute for Health and Care Excellence (*Bisson, I. Jones*); Medicines and Healthcare Products Regulatory Authority (*Walters*); British Association of Psychopharmacology (*Hall*); Royal Colleges (*I. Jones, Walters*); and international organisations including the World Health Organisation (*Owen and I. Jones - ICD-11 taskforce*). Recently, *Pidgeon* informed discussion at the Cabinet Office and Foreign and Commonwealth Office International Comparators Joint Unit for assessing responses to Covid-19. Our researchers have had significant impact. For example, the “Everybody’s Business” campaign with the NHS, chaired by *I. Jones*, resulted in over £375M in new funding for specialist perinatal mental health teams across Wales and England, with further progress anticipated in Scotland and Northern Ireland (see impact case study). Also, *Kerr’s* research led to a further impact case study on development of the Cardiff Health Check, a tool allowing GPs in Wales and England to identify formerly undiagnosed (and unmet) health needs in adults and young people with learning difficulties.

4.5.3. Enterprise

We influence policy and practice in energy companies (*Demski, Pidgeon*). Industrial partnerships aligned to HuFEx, together with a broad range of stakeholders, enabled co-produced research and impact. For example, we engaged in collaborative product development with technology-based SMEs (e.g., fertility animations and awareness apps, *Boivin and Gameiro*; the THINCS training and evaluation app for the UK FRS funded by the ESRC, *Honey*; and the MiND cognitive biomarkers app funded by a £490K MRC-ESRC GCRF award, *Graham*). Research relating to fertility awareness (e.g., using animations and apps) informed fertility policy in Japan, which forms the basis of *Boivin’s* impact case study. Our research also informed staff training, development and evaluation in the broader emergency services, and we are represented on the Academic Reference Group for Her Majesty’s Inspectorate of Constabulary and Fire & Rescue Services (*Honey*).

4.5.4. The impact of our research was recognised nationally and internationally

Shelton and *van den Bree* received the Innovate UK Best of the Best Award in 2015 for a KTP with Llamau, the leading homelessness charity in Wales. The KTP addressed the vulnerability of young homeless people to mental health problems. *Shelton’s* second KTP with St. David’s Children Society (which aligns with her impact case study) was awarded the Innovation Award 2018 at the House of Lords by the Institute for Collaborative Working and British Standards Institute. *Honey* and *Cohen-Hatton* received the BBSRC Innovator of the Year Award 2018 for their research and its impact on decision-making in the emergency services; this award aligns with their impact case study. Their underpinning research received the American Psychological Society’s Raymond S. Nickerson Prize in 2017, recognising the potential for enduring impact in the area of applied experimental psychology; and *Cohen-Hatton* (now a Cardiff University Fellow) won the American Psychological Association New Investigator award 2017. *Craddock* and *I. Jones* won the British Medical Association Innovation in Medicine award in 2014 for their development of Bipolar Psycho-education programme. The P&R group received the 2018 Health and Care Research Wales Public Involvement Award. *Thapar* received a CBE in 2017 for *services to child and adolescent psychiatry*. *D. Jones* received an MBE in 2019 for *services to medical imaging and the promotion of engagement in science*. *Owen* was knighted in the 2014 Birthday Honours list for *services to neuroscience and mental health*. *Pidgeon* received an MBE in 2014 for *services to Climate Change and Energy Security Policy*. The MRC Centre was recognised with a Queen’s Anniversary Prize for achieving outstanding transformative insights into causes, diagnosis and treatment of mental illness.

4.6. Stakeholder and public engagement strategy

ECRs drive our science communications and public engagement programmes through bespoke events (e.g., Brain Games, Brain Night, Einstein’s Garden at Green Man Festival, Hay and Cheltenham Science Festival talks). These events attract tens of thousands of visitors. For example, Brain Games attracted 3,670 attendees in 2019. Our ECRs also gained funding (e.g.,

Wellcome ISSF public engagement awards) to develop public engagement, including computer games development with a mental health theme (JAMMIND), animations on ADHD and other disorders, and artistic events such as *How the Light Gets In – Conversations between Art, Science and Health*, an exhibition which explored the process of taking part in genetic and mental health research through art. We also developed *Brain Box* to support understanding of brain function in schools. The kit consists of a set of interactive games and demonstrations (used by >400 students during lessons across 20 schools in Wales), and an aligned VR MRI brain scan (viewed >126,000 times on YouTube).

We enhanced dissemination of our research to stakeholders through new websites (e.g., fertility awareness), videos (e.g., CU's annual Innovation and Impact Awards), Open Days, and visits by sixth formers (e.g., Nuffield Research Placements). The NCMH engaged the public and wider stakeholders in their research (see Figure 4). It recruited 28 'Research Champions' who featured in associated videos talking about their experience of mental health problems and why they chose to participate in research with the Centre. Finally, our research received frequent coverage on radio, TV and print media including a major BBC TV documentary presented by Charlotte Church and a half-hour radio Wales documentary focussing on the NCMH.

Patient, family and carer engagement and participation is a central mission. This mission is exemplified by the Partnership in Research (PÂR) initiative and the work of the Wales Autism Research Centre (WARC). PÂR encourages service user and carer involvement in mental health research (see Figure 4) and hosts regular surgeries where researchers can get feedback to shape grants applications. Among other activities, researchers in WARC developed a short film, *The Birthday Party*, which supported broader understanding of autism across international stakeholders. The research on which the film is based underpins the impact case study led by *Leekam*. Relatedly, research highlighting the benefits of the 'Supported Employment' model for people with autism and learning disabilities underpins the impact case study led by *Beyer*. The platform and ethos of PÂR and WARC ensure our research will continue to have broad and sustainable impact in the future aligned to successful delivery of our future aims (Section 1.4).



Figure 4. Making a difference with the National Centre for Mental Health.

4.7. External recognition

Prestigious awards and honours across career stages include: *Gameiro*, Welsh Crucible/Learned Society of Wales Award for the Best Collaborative Welsh Crucible Project 2011-2015; *D. Jones*, James Bull Medal 2019, British Society of Neuroradiologists 2019; *Livingstone*, BPS Neil O'Connor Award; *C. Morey*, Psychonomic Society Early Career Award 2017; *R. Morey*, Psychonomics Early Career Impact Award, Federation of Associations in Behavioral & Brain Sciences 2017; *Owen*, Lifetime Achievement Award, International Society of Psychiatric Genetics 2016; *Walters*, Academic Researcher of the Year, Royal College of Psychiatrists 2019; *Thapar*, Professor of Psychiatry Club Academic Women in Psychiatry Award (joint) for enhancing the careers of academic women in psychiatry 2017, Learned Society of Wales Frances Hoggan Medal for outstanding research by women in Science 2017, Royal College of Psychiatrists' President's Medal 2015 for contribution to policy, public knowledge, education and meeting population and patient care needs.

The following have been awarded fellowships: *Thapar*, Learned Society of Wales, Academy of Medical Sciences; *Culling*, Acoustical Society of America; *Williams*, *Gruber*, Memory Disorders Research Society; *Haddock*, Society of Personality and Social Psychology; *Peall*, European Society of Neurology.

Keynote and plenary addresses at national and international conferences include: *Aggleton (2016)*, *Honey (2017)*, *D. Jones (2015)*, British Psychological Society; *Culling*, Ted Evans Lecture at the British Society of Audiology 2016, Tohuko Forum for Creativity 2018; *Gameiro*, European Society for Embryology and Human Reproduction 2019; *Hall*, *Owen*, *Thapar*, Royal College of Psychiatrists International Congress (2015-2019); *D. Jones*, International Society for Magnetic Resonance in Medicine; *Lewis*, International Conference on Computational Creativity 2018; *R. Morey*, Royal Statistical Society 2018; *Morgan*, Symbiotic Intelligent Systems Osaka 2019; *O'Donovan*, Ming Tsuang Lifetime Achievement Award Lecture 2020; *Pidgeon*, Decarbonising UK energy, Royal Society 2017; *Rees*, American Endocrine Society 2019; *Thapar*, Academy of Medical Sciences 2020; *Walters*, European Society of Human Genetics 2019; *Williams*, Alzheimer's Association International Conference 2017.

Best papers and academic books in the field include: *Culling*, Jos Miller Prize, *British Journal of Audiology* 2018; *D. Jones*, Editor's Choice *Human Brain Mapping* 2014. *Chambers'* book, *The Seven Deadly Sins of Psychology: A Manifesto for Reforming the Culture of Scientific Practice*, has received many accolades, including the British Psychological Society Academic Monograph Award 2018. In 2020, *Graham* with international collaborators won the British Psychological Society Academic Monograph Award for *The Evolution of Memory Systems: Ancestors, Anatomy and Adaptions*.

4.8. An integrated approach to research and research impact

Our researchers have resources that enable them to thrive, including extensive support for career development and innovation activities, and state-of-the-art facilities. Interdisciplinary research is supported locally, regionally, and internationally. We have structures in place to facilitate our ambition to grow future industrial and strategic partnerships. This integrated approach will enable our researchers to continue to make important contributions to the research base, economy, and society, providing a platform for achieving of our strategic aims in the next decade.