Institution: University of Nottingham

Unit of Assessment: Psychology, Psychiatry and Neuroscience (UOA4)

1: Unit context and structure, research and impact strategy

1.1 Overview

Our vision is to deliver scientific research and societal impact through advancing scholarship and its implementation across the broad spectrum of psychology, psychiatry and neuroscience.

The university hosts a vibrant and stimulating research environment in which we engage in discovery, applied and health science to advance knowledge and deliver impact. Our return is based on a multidisciplinary team of 93 FTE staff, from the School of Psychology (SP) 51.6 FTE, the Divisions of Psychiatry and Applied Psychology (DPAP) and Clinical Neuroscience (DCN) in the School of Medicine (SM) 35.4 FTE, and the School of Life Sciences (SLS) 6 FTE. We have grown by ~75% (up from 53.2 FTE) since REF2014 and are proud to have supported 327 successful PhD awards in the assessment period. Other notable achievements include:

- Actively delivering patient benefit: for example, leading the mental health theme in the NIHR-funded (£20M since 2014) CLAHRC/ARC regional collaboration to improve the quality, delivery and effectiveness of healthcare in the East Midlands.
- MindTech, the NIHR-funded centre for interdisciplinary, clinically-applied research in digital technology and mental health, which leveraged >£109M in grant funding, with >80 projects recruiting >14,000 participants including major trials of digital technology for mental health.
- Directly influencing policy and shaping national and international guidelines (e.g. NICE, NHS England, WHO) for those with auditory impairments, multiple sclerosis (MS), attention-deficit/hyperactivity disorder (ADHD) and schizophrenia, and for trans and gender-diverse people.
- Engaging with and being funded by industry (over £1M in assessment period) to improve real-life impact e.g. Ford, Jaguar Land Rover, The Together Agency, Health Data Research UK, Oticon, Tokyo Electron.
- Demonstrating impact across the breadth of our disciplines, with local and global research involving a diverse range of partners. For example, research collaboration with Voluntary Services Overseas (VSO) examining the effectiveness of an innovative educational intervention in low income countries, joint winner of the $15M Global Learning XPRIZE.
- Gaining £34.6M research grant income from £47.9M in awards, £2M university strategic funding, and benefitting as co-applicants from in total £87M in awards distributed through NHS trusts or other bodies.
- Contributing over 2,300 peer-reviewed publications in discipline-leading journals, including the Nature series, Lancet series, British Medical Journal, Brain, Neuron and Current Biology.
- Average field weighted citation impact of 1.76 exceeds the global average with 76% more citations than expected; 19.8% of our publications are in the top 10% citation percentiles (field-weighted)' and 41.2% involve international collaboration.
- Continuing to make significant contributions to Open Science (e.g. the PsychoPy experimental platform used widely across academic and industry settings, Human Connectome Project (HCP) processing), public engagement in science (Summer Scientist Week, Café Connect) and patient and public involvement (PPI) in research (MindTech PPI panel and CANDAL annual conference).

We play a key role in cross-university interdisciplinary initiatives (especially the Precision Imaging Beacon of Excellence and the Interdisciplinary Research Cluster in Health and Wellbeing; REF5a;2.1a), have extensive academic collaborations with other institutions, and lead major university-NHS collaborations including the Hearing and Mental Health Technology themes within the Nottingham Biomedical Research Centre (BRC), Institute of Mental Health

(IMH) and East Midlands Applied Research Collaboration (ARC). The BRC drives innovation in experimental science and translates research into breakthrough treatments, technologies and medicines; IMH advances healthcare through promoting innovation, evaluation and clinical excellence across NHS services; and the ARC focuses on improving the quality, delivery and effectiveness of healthcare in the East Midlands. We are strongly committed to promoting and delivering a fair and transparent environment for all staff as demonstrated by successfully holding and renewing Silver Athena Swan awards since 2008 (SP), 2013 (SLS) and 2015 (SM).

Our research is conducted in specialized laboratory and buildings across university sites, including co-locations within the NHS, allowing easy access to patient groups. Neuroimaging studies utilise and enhance (through methodological developments) state-of-the-art imaging facilities and expertise within the Sir Peter Mansfield Imaging Centre. Additional bespoke facilities include human cognitive testing facilities (e.g. EEG, TMS, driving stimulator, 'Toddler lab'), biomedical-based laboratories (e.g. preclinical scanning, surgical and behavioural suites for in vivo work and high quality microscopy services), auditory laboratories for basic and clinical studies, and high performance computing (HPC) services for large scale data processing. We partner the £5.1M NIHR-funded East Midlands Research Design Service (RDS) providing high quality methodology and funding advice for applied health research.

1.2 Research vision and overall strategy

We aim to enhance understanding of psychological and neurological bases of behaviour and dysfunction whilst striving to improve patient care and deliver benefits to wider society. Our vision is to deliver scientific research and societal impact by advancing scholarship and its implementation. Our research vision is underpinned by our discipline-specific strengths and diverse research groupings that span the breadth of fundamental through to clinical research in psychology, psychiatry and neuroscience. This is delivered through our strategies for research, knowledge exchange and impact (see 1.7).

1.3 Achievement of strategic aims for research during the assessment period

We achieved our REF2014 aim to build research capacity in computational neuroscience, social cognition and the psychology of mental health with 13 R&T appointments. We now have critical mass in *Computational Neuroscience*, achieved by the appointment of two professorial staff, Humphries and van Rossum (joint with the School of Mathematical Sciences), who secured funding for 6 postdoctoral scientists to work on interdisciplinary projects, including the computational role of sleep in memory processing and the effect of metabolic constraints on neural computation. We led in establishing a new interdisciplinary MSc in Computational Neuroscience, Cognition and AI which will feed the pipeline to funded PhD opportunities, e.g., via the university BBSRC and EPSRC doctoral training programmes. We now host the annual UK Neural Computation meeting.

Social Cognition developed into an area of strength through the appointment of 5 staff who also consolidate our expertise in the psychology of mental health. We established a new MSc in Developmental Disorders which will also feed the PhD pipeline. SP has long-standing collaborations with DPAP which complement and join up our mental health research (e.g., S Jackson and G Jackson; Townsend and Daley, Glazebrook, Sayal, Arcelus).

We continued to capitalise on our track record in *Cognitive Neuroscience*. New achievements, building on the Nottingham Child Neuroimaging Initiative launched 2013, were supported by external charity funding, NIHR, and the Precision Imaging Beacon.

New clinical research groups included *Clinical Neuropsychology*, bringing together researchers, clinicians, patients and the public to develop research portfolios for mental health and psychological wellbeing of people with long-term neurological conditions, specifically MS, stroke, and traumatic brain injuries. Arcelus was appointed as the first Clinical Professor in Transgender Health in the UK. The new *Transgender Health and Mental Health* group works collaboratively with the Nottingham Centre for Transgender Health, the only clinical academic centre in transgender health in the UK and one of only three across Europe.

We achieved our REF2014 aim to build research capacity in the areas of psychiatry and applied psychology through the IMH partnership. Notable examples include: the NIHR CLAHRC/ARC

(Morriss leads the mental health theme); the NIHR MindTech centre (Hollis), which provides infrastructure (staff, PPI and pump priming) to support interdisciplinary clinically-applied research in digital technology and mental health; the NIHR Nottingham BRC mental health and technology theme (Hollis); and the Cochrane Schizophrenia Group, an international centre of excellence for systematic reviews (1,300 reviewers in 41 countries) to review schizophrenia therapies and maintain a sophisticated and large database of clinical trials (>300), which trained over 100 researchers in systematic reviews. A further aim was to develop the Centre for Dementia established in 2014 following establishment of a chair (Dening). Subsequent senior academic appointments included Orrell, Stephan (both Chairs), Rajkumar and Yates.

We strengthened hearing research by integrating the MRC Institute of Hearing Research into the university and subsequently appointing three new researchers (Cederroth, Hadley, Sollini). Kitterick leads the hearing theme of the BRC. Major research achievements include advancing core outcomes and standards for questionnaire translation (Hall, Kitterick) and demonstrating that functional near-infrared spectroscopy offers an objective measure of speech intelligibility (Hartley). We also succeeded in our aim to expand neuroimaging research, especially into new analysis methods and understating brain architecture, with the appointments of Sotiropoulus, Bastiani and Chappell (Chair). Within SLS we created the division of Physiology, Pharmacology and Neuroscience (PPN) to deepen our molecular understanding of human health.

1.4 Achievement of strategic aims for impact during the assessment period

Our aim has been to embed the importance of impact throughout our research culture. We appointed 5 academic staff at different stages of their career as impact champions. Best practice is disseminated through their work on local research committees and their cross-faculty activities to support university-level initiatives (e.g. Pitchford is an executive panel member for the university's ESRC Impact Accelerator Account (IAA) and academic lead for the Partnerships for Impact Network).

The impact champions work with impact support staff and research and business development managers to develop research impact from planning to delivery. All staff are encouraged to engage in impact training in the unit (e.g. sessions for ECRs and PGRs and at staff awaydays) and the wider university (e.g. Impact Leaders Programme, Institute for Policy and Engagement training). PGRs receive impact training and are encouraged to engage in impact activities throughout their doctoral degrees. Training includes the writing and implementation of impact plans, to maximise impact potential from the conception of the research project to beyond its funded lifecycle. Clinical doctorate students (and other PGRs with a clinical focus) routinely present their research proposals and findings to PPI groups.

We are supported by the Nottingham Impact Accelerator (NIA) to support outreach, innovation and business engagement (REF5a;2.2). All staff are encouraged to apply for funding including external UKRI/GCRF IAA funds and internally-funded impact schemes (IAA, Knowledge Exchange awards, Hermes Fellowships; school research committee support).

Research from the *Clinical Neuropsychology* group fed into the 2018 surveillance proposal for MS in adults (NICE guideline CG186). Cochrane schizophrenia reviews are widely embedded in NICE guidelines and internationally (e.g. WHO mhGAP). The group's clinical trials in Brazil, India and Lebanon on effective management for acutely aggressive psychotic people changed guidance and practice (NICE [NG10]). Research by *Transgender Health and Mental Health* has been adopted by the WHO to support the new diagnostic category for the ICD-11. In 2017, the team created and validated the first outcome tool for transgender health services, subsequently translated into six languages and currently under consideration as the outcome measurement by NHS England. Longitudinal studies on the role of gender-affirming hormone treatment in mental health shaped global guidelines for the treatment of trans and gender diverse people (Standards of Care edition 8), currently being developed by the World Professional Association of Transgender Health in collaboration with Johns Hopkins University.

Technologies evaluated by MindTech and adopted by the NHS included Alpha-stim Cranial Stimulation (for treatment of Generalised Anxiety Disorder) and ProReal (avatar programme for treatment of borderline personality disorder and emotional difficulties). The Nottingham Child Neuroimaging Initiative is currently developing a portable electrical stimulation device for home

use (patented) through a university spin-out *Neurotherapeutics*. This self-managed therapy reduces tics and unwanted urges in patients with Tourette syndrome, and ~£650K of external investment has been raised to conduct a placebo-controlled clinical trial.

1.5 How the selected case studies relate to strategy for achieving impact

Impact has been realised within wide-ranging national and international policy arenas, on professional practice and on research methodology and teaching. Impact cases studies (ICSs) were developed from work in the Impact Leaders Programme or IAA-funded projects and several examples are award-winning. Feedback from a series of internal reviews has been used to further develop and evidence impact:

- Making Britain's roads safe: Translating hazard theory into road safety practice (Chapman); research programme using the Nottingham Integrated Transport and Environmental Simulation facility, with impact activity supported by the Impact Leaders Programme, Institute of Policy and Engagement and collaboration with Lodestone Communications.
- Transforming the selection of medical practitioners in the UK and Australia with the application of a novel competency model (Ferguson); recruitment tool rolled out to the Medical Royal Colleges, drawing on IAA-funded activity.
- PsychoPy: Increased efficiency and capacity for behavioural studies through the development of high-precision, open-source software (Peirce); demonstrates global adoption by industrial, governmental and educational institutions, averaging 25,000 users per month; highlighting our commitment to open science.
- Unlocking talent through tablet technology: Raising attainment in numeracy and literacy skills in marginalised children worldwide (Pitchford); detailing the global impact of a research collaboration with not-for-profit onebillion and VSO, examining the effectiveness of an innovative educational intervention in low-income countries.
- Transforming worldwide policy and practice to prevent psychosocial risks and work-related stress at work (Leka); recommendations adopted by the EU and WHO.
- Transforming diagnostic assessment of ADHD in children and young people (Hollis); 'QbTest' a computerised tool adopted nationally by all Academic Health Science Networks.
- Tackling the taboo and lack of awareness about menopause and work for mid-life women (Griffiths).

1.6 Approach to supporting interdisciplinary research

Trans-, inter- and multi-disciplinary initiatives are fundamental to our research vision to address longstanding and emerging research challenges and are supported by a number of platforms as follows:

Our joint NHS/university NIHR BRC's mission is to drive innovation in experimental science and translate research into breakthrough treatments, new technologies and advanced medicines. Its themes encompass a number of our research topics, including neuroimaging, neuromodulation, hearing, and mental health and technology.

The Precision Imaging Beacon aims to translate improved understanding of diseases with the development of revolutionary personalised treatments to have the greatest impact on society. We have 27 Beacon members (from PGR to professor) who collaborate in Beacon-funded projects and benefit from Beacon-sponsored activities. Beacon project funding of over £30K included: computational models of white matter networks; novel neuroimaging approaches to investigate brain correlates of Tourette syndrome; establishing an imaging protocol to measure locus coeruleus structure and function in mental health and neurological disorders; AI diagnostic support for medical imaging via gaze tracking; and the Global Alliance of Medical Excellence network (Jung champions our links with Korea). The Beacon has also supported UOA4 appointments from fellow (Bastiani, Jung) to chair (Chappell), two non-independent research

fellows, 3 PhD students, and enhanced our research culture with a series of funded workshops, seminars and 'Evidence Club' drop-in sessions with a senior statistician and information specialist.

UOA4 members participate in an Interdisciplinary Research Cluster in Health and Wellbeing. This is a university-funded, academic boundary-crossing initiative which fosters networking opportunities to develop new research with colleagues in economics, pharmacy, arts and humanities, environment and food sciences, and other medical and healthcare specialties.

Our expansion in Computational Neuroscience represents a substantial multidisciplinary investment. Similarly, work on mechanisms of brain injury and disease transcends traditional disciplinary boundaries. Staff engagement initiatives led to potential research directions to prioritise based on the availability of funding and opportunities to develop cross-faculty collaborations, e.g. the Psychology of Ageing forum and a Mental Health and Wellbeing network. Neuroscience@Nottingham has held an annual event to bring together neuroscientists across the faculties.

1.7 Future strategy: aims and objectives for the next REF period

Our strategies are process-based and are developed following consultations with staff (workshops and awaydays; drop-in sessions) and the wider research community (members of BPS research board, members of UKRI and NIHR panels). We have shown agility in our responses to the Covid-19 pandemic in the REF period in terms of practical support and policy advice (Daley, Hollis, Pitchford), measuring changes in mental healthcare informatics during lockdown (Nixon), research on behavioural responses and psychological effects of the pandemic (Ferguson, Tungenc), risk assessment of immune suppressant medication in MS (das Nair), associated ethical and societal considerations (Cassidy, Townsend), and the development of new online platforms and toolkits (Madan, Pitchford).

Specific commitments include to:

1) increase the number of successful fellowship and other research applications to support ECRs to build independent research careers (with 50% obtaining funding);
2) consolidate research in interlinked research groups within the IMH, and with local NHS Trusts and interdisciplinary research clusters across the university, and other networks nationally and internationally to increase research capacity and success;
3) lead innovation through advances in research methodology and PPI;
4) develop capacity and opportunities for social care-related research in mental health;
5) develop individualised action plans for knowledge exchange and impact;
6) grow our portfolio of research with a neurodiversity or other EDI focus;
7) build on existing research in the Centre for Mood Disorders; mood disorders also feature in MindTech's portfolio, four of the subthemes of the BRC, the Precision Imaging Beacon and new ARC;
8) increase NC3Rs funding (building on recent successes);
9) pursue integrative research programmes in PPN, from structural and functional studies of individual molecules to whole organism neuroscience.

1.8 Mechanisms to take our strategies forward

Our research, impact and knowledge exchange leads promote strategic priorities at senior management groups and represent their schools/divisions at faculty/school research boards. Strategy leads and Heads of School/Division use a range of opportunities to make themselves available to staff informally, e.g. at weekly staff coffee meetings, career development lunches, one-to-one sessions and open-door drop-in sessions (replaced with Teams chat forums since Covid-19). Research group and centre directors represent us at both the IMH and DPAP strategy and management committees. The head of DPAP (Orrell) is Director of the IMH and sits

on the School Management Committee to facilitate the development and implementation of research policy.

We support grant applications with bespoke training for ECRs and Assistant/Associate Professors. Associate Professors can also shadow and/or deputise for the research leads at faculty/school research boards, to network, observe, and contribute to research strategy development.

We continue pump priming funding for promising proof of concept projects and support applications through a variety of university mechanisms (Faculty of Science Paper Enhancement Fund, MRC Confidence in Concept). To promote staff engagement with our strategy to promote interdisciplinarity (and encourage collaboration across research groupings) we are fostering cross-cutting networks to address long-standing and emerging research challenges in healthy ageing, mental health and digital technologies.

1.9 Open research environment

We are committed to open access (OA) publication, open research data and open science. Researchers are required to make research outputs (including datasets) open access and deposit them in the university repository. The university supports a mixed green and gold model of OA publication. We have agreements with major publishers to fully/partially waive article-processing charges. UKRI/Charity Open Access Fund block grants are used for research funded by UKRI, Wellcome Trust and other health research charities. Additional gold OA is supported through school and divisional funds.

Initiatives to promote open science include:

- central training courses on OA, research data management and transparency of scientific methods;
- awaydays and internal seminars to update staff on open science initiatives;
- developing research policies and promotions criteria based on the openness and reproducibility of research;
- encouraging publication of methods protocols and use of open registries for prospective trials;
- use of externally searchable open datasets (with fully-documented/automated analysis pipelines and processes);
- funding for staff to publish data articles (‘Data in Brief’);
- making peer review histories open access;
- editorial board membership in prominent open access journals (Royal Society Open Science, Cortex) which make transparency and openness a requirement for publication;
- creation of an open-source project providing a graphical user interface for interactions with research data, and ANIMA, a data-sharing initiative for neuroimaging meta-analyses (Reid);
- PsychoPy (Peirce), an open-source application allowing non-programmers to run a wide range of neuroscience, psychology and psychophysics experiments, used widely across academic and industry settings.

Researchers routinely deposit all data, code, scripts and supplementary materials from published outputs, using a number of repositories including the Open Science Foundation, Open Science Framework, github, the Elsevier Zenodo and Mendeley Data Platform and the university research data management repository. We have contributed to a number of publicly-released neuroimaging databases with MRI scanning protocols and the NIH Lifespan extension to the HCP (Bastiani, Sotiropoulos). Sotiropoulos led on HCP processing pipelines which have attracted >1500 Google Scholar citations and co-developed the FSL open-source software one of the de-facto packages for brain image analysis (with >5,000 users in ~1,000 institutions worldwide). Sotiropoulos was also lead author for a number of FSL toolboxes, including

"bedpostx", "eddy", "probtrackx_gpu", "xtract" with >1400 Google Scholar citations of his FSL contributions since 2014. The UK Biobank (Sotiropoulos) provides population-level neuroimaging data from 100,000 subjects, with 50,000 already available to the community. The ERC Developing HCP (Sotiropoulos) provides data from 500 neonates, scanned within 2 weeks of birth. Bastiani has developed open-source software used widely by thousands of researchers: for automated processing of neonatal diffusion MRI data; for automated diffusion MRI quality control; and for estimation of asymmetric fibre orientation distributions from diffusion MRI data.

All PhD theses are similarly deposited, attracting over 29K downloads in SP alone, of which 12 have been downloaded more than 500 times.

We also contribute to the university Digital Research Strategic Plan which included piloting the use of electronic laboratory notebooks (Holmes).

1.10 How Nottingham UOA4 supports a culture of research integrity

Ethics

We follow the rigorous standards of the university's Research Integrity Code underpinned with extensive training in research ethics and methods. Research with human participants adheres to BPS research guidelines, BPS Codes of Ethics and Conduct, Human Research Ethics and publishing standards. The University Code of Practice on Handling Allegations of Research Misconduct aligns with UKRIO and UUK processes. Studies involving patients are submitted to the Health Research Authority and National Research Ethics Services. Healthcare studies follow ethical principles in line with the Declaration of Helsinki, 1996; the principles of Good Clinical Practice and the UK Department of Health Policy Framework for Health and Social Care, 2017.

Ethical approvals are considered by NHS committees or local ethics committees for research studies with human participants. Their chairs also deal with concerns/complaints.

Research integrity is driven by the Research Ethics and Research Integrity Committee. Nominated staff within the unit are further points of contact and they collate data and activities for the Research Integrity and Research Ethics Annual Statement.

Our Health and Safety Committees review our risk assessments. Much of our work is low risk but appropriate protocols are in place for higher risk projects, e.g. TMS.

Training and information

Researcher Academy research integrity training is mandatory for PGR students and attendance data evidence their engagement with the training. Staff attend courses run by the university Leadership and Management Academy, many of which include a research integrity component. Eight members of UOA4 have undertaken formal core programmes and a further 52 have undertaken "bitesize learning" modules online since the Academy's launch in 2016. Induction materials for new staff include data management and data sharing, research ethics and integrity, and ways of raising concerns. Strategies to reduce risk include sessions on Open Science, including pre-registration, data sharing, rigour and reproducibility. Locally organised seminars educate researchers about the Data Protection Act and GDPR, to ensure that data collection and storage adhere. Support with data management plans includes internal peer review systems, examples from recently funded applications, and encouraging applicants to have their statements reviewed via the library ('DMP online').

Animal studies

Research involving animals is managed through our Animal Welfare and Ethical Review Body (AWERB) and conducted under Home Office Licence authority. In vivo studies conducted in the Biomedical Support Unit aim to Reduce, Refine and Replace (3Rs) the use of animals and our annual 3Rs workshops promote best practice across the Midlands. Published studies conform to the ARRIVE Guidelines. Bonardi and Sumner have been members of our AWERB.

PPI

Research integrity is supported by our extensive PPI activity. The *Hearing* group plays a prominent role in PPI within the BRC and SM including co-creating the East Midlands Lay Assessor training programme, and the East Midlands Sharebank (a novel model, based on

reciprocation, for organisations/staff/patients/public to share PPI research knowledge and skills). Sharebank has been rolled out nationally by INVOLVE (the NIHR-funded advisory group for advancing public involvement in research). The *Transgender Health and Mental Health* team has developed a very active PPI group with over 40 members of the trans community. Clinical psychology doctoral students have access to a paid service users and carer involvement panel. There is also a MS PPI group co-chaired by two individuals with MS who have been co-investigators on several research projects. PPI activities by this group were identified as meeting national best practice (Bloomsbury REC, the MS Society's PPI training day). Guidelines on involving people with dementia as peer researchers were published by the Centre for Dementia. We have also (with the James Lind Alliance) developed research priority lists for hyperacusis (Hoare) and technology use in mental health (Hollis).

2: People

2.1 Staffing strategy and staff development

Staffing strategies and development plans aim for a diverse workforce and the wellbeing of our staff is paramount. All appointments are aligned with our initiatives to support EDI and strategies for research, knowledge exchange and impact.

Our recruitment strategy is based on *replacement*, taking into account research and teaching needs, *succession planning* and *research leadership*. We aim to attract high calibre individuals to enhance research strengths (and teaching and/or clinical provision). We typically appoint at the assistant professor level (associate in the case of clinical academics) and support development through internal promotion of ECRs. Strategic senior appointments provide additional leadership in specific areas e.g. computational neuroscience, global health and ageing. New ECRs on R&T contracts have reduced teaching loads and research and teaching mentors. ECRs are well-represented across committee structures and post-docs are also invited to sit on relevant committees (e.g. EDI). Deputy roles are usually for more junior members of staff, enabling them to develop the required skills to take on future leadership roles. All our posts are open to working part-time, offering greater flexibility.

Across the unit, 45.4% of academic staff identify as female of which 84% hold a permanent contract and 11% opt to work part-time (86% of men are employed on permanent contracts and 2% work part-time). The available data show gender parity at the levels of assistant and associate professor with 34% female professors (up from 16% in 2015). Since 2014, SP appointed 13 assistant professors (7 female) and 5 professors (1 female). Across the unit, 1% of staff report a disability and 1% prefer not to say. Our ethnicity split is 12.8% BAME, 82.9% white and 4.3% unknown.

We conduct regular surveys to understand the needs of staff and typically achieve over 60% response. These have been combined with staff focus groups, including specific sessions for maternity issues, for both R&T staff and clinical academics.

<u>Recruitment</u>

Adverts highlight wellbeing initiatives and family-friendly policies (e.g. flexible working, shared parental leave) and signpost to employee hub benefits. Template role profiles use a gender de-coder to avoid bias. The vacancy management system structures application questions to avoid unconscious bias and shortlisting is undertaken without knowledge of protected characteristics. We actively encourage applications from less represented groups (REF5a;1&3.1). Shortlisting/interview panels are gender balanced. We have engaged with a new initiative, Diversity by Design (see 2.3). All interview panel members undergo EDI and unconscious bias training.

<u>Induction</u>

New recruits have one-to-one structured inductions with their line manager, research, teaching and EDI leads, and are invited to local welcome events. Our ethos, including EDI policies, is emphasised in our induction pack. Buddy systems give new starters an informal point of contact outside of line management.

Development

Several mechanisms operate to attract and retain the next generation of high-quality researchers: e.g. internal funding of research fellowship posts; a dedicated fellowships officer who works proactively to attract high quality candidates through the Nottingham Research Fellowship and Anne McLaren schemes; staff can participate in university doctoral training programmes (NIHR, BBSRC, MRC Impact, EPSRC and ESRC); and have mentoring and support with grant writing.

Study leave for 1-2 semesters is available to academic staff. Cases are considered on merit and in relation to the strategic aims of the school/division and university.

An extensive range of professional development courses is available for staff and students. Our Leadership and Management Academy (LMA) (established 2016) provides courses, online resources for performance management and personal diagnostics and coaching and mentoring. The university's Research Leaders Programme was completed by Webb (2014), Pitchford (2015), Townsend (2015), Moran (2016), Tunney (2016), Hall (2016), and das Nair (2018). Staff also completed the Future Leaders (Allen) and Leadership for High Performing Teams (Kitterick) programmes within the LMA. Subsequently staff took up research leadership roles at School/Faculty level: impact champions (Pitchford, Moran); PE Steering Group (Townsend); Vice-Provost Research and Knowledge Exchange at University Malaysia and NIHR Senior Investigator (Hall); DPAP Director of Research and Chair of the NIHR's Research for Patient Benefit – East Midlands Region (das Nair). Kitterick was promoted to lead the BRC's Hearing theme. Lawrence and das Nair completed the VC mentoring scheme including shadowing opportunities with the VC and PVCs.

NIHR-funded clinical academic training posts in SM, hosted in partnership with local NHS Trusts and Health Education England, funds Academic Clinical Fellows/ Lecturers doing PhD/MDs during their clinical training.

Recognising and rewarding staff

Drawing from best practice, the university's approach to performance-related reward is now separate to annual staff development review. The Nottingham Reward Scheme allows individuals and teams to be nominated/self-nominated for a range of monetary awards. Excellent contributions (either output- or behaviour-based) can be recognised at any time, while sustained excellence demonstrating positive impact and wider contribution are recognised through regular review.

A workload plan model ensures (as far as possible) equitable distribution of work and measures are taken if individuals exceed the 100% allocation by a significant and sustained margin. Knowledge exchange and public engagement activities are included in the model.

Promotion

The annual Appraisal and Development Conversation is used to highlight excellence in research outputs, knowledge transfer and/or impact, which are recognised in our promotion benchmarks. We actively support promotion, highlighting opportunities and deadlines to all staff and working with applicants to develop their cases.

Our EDI committees identified barriers faced by women and introduced specific measures to overcome (e.g., flexible working, promotions workshops).

Support for ECRs

We are committed to implementing the Concordat to Support the Career Development of Researchers. The Researcher Academy training maps to our Researcher Development Framework which describes the knowledge, behaviours and attributes of successful researchers with a wide programme of online and face-to face short courses for PGT/PGR students and ECRs (Managing Your Research, Research Skills & Techniques, Research Governance, Writing, Communication & Networking Skills and Entrepreneurship). An online Supervisor Toolkit is also available.

We appointed two internally-funded research fellows to specific projects, and independent research fellows supported through internal (N=4) and external funding schemes (N=4). We also attracted three Nottingham Research Fellowships, two Anne McLaren Fellowships and a Newton International Fellowship. In addition to individual fellowships, ECRs are appointed and supported through grants from the NIHR and charity sector. We hosted two EU funded Marie Sklodowska-Curie Innovative Training Networks (INDUCT and DISTINCT) which funded 30 early career fellowships in dementia across Europe, four based in DPAP.

ECR and research fellows receive an induction pack and a programme, which includes meeting the director of research, and are allocated both a buddy and research mentor. Career development lunches with research leads and other senior staff are held regularly alongside ECR group meetings and workshops (UKRI, Wellcome, NIHR fellowships). Honorary contracts with NHS Trusts link clinician research with services. Further opportunities to speak to key staff about career progression and CV development include 'Meet and Mingle' and 'CV Spa' events. Astle completed a leadership programme for ECRs. DCN has a dedicated training lead (Hoare) and a reserved budget for training for advanced courses that ECRs would otherwise be unable to attend. PhD students and ECRs receive practical instruction in audiology, delivered by NHS professional audiologist clinical staff, and can observe audiological and implant clinics in action.

Support with grant writing and impact

Feedback and advice: Grant applications receive internal peer review and feedback: e.g. using a Grant Advisory Panel to refer applicants to academics with some track record with the specific (or similar) funder, for advice and support; the East Midlands RDS offers advice for grant applications, particularly NIHR; research and governance advice 'clinics' are run by Nottinghamshire HealthCare R&I; and online and face-to-face statistics support for SM staff includes a weekly drop-in statistics clinic, longer-term support and access to potential collaborators. Applicants are also referred to the impact and engagement champions, to help them to strengthen their applications and maximise delivery if successful.

Mentoring: Mentoring is available to all staff and PGR students. We provide internal training for mentors and mentees and invest in external training. Engagement of staff and PhD students is good, and the schemes are highly rated by mentees and mentors. Mentees report benefits to career progression and confidence whilst mentors report that they feel they have helped their mentee and found the experience personally fulfilling. SM is an active member of the HEE-NIHR pre-doctoral and post-doctoral bridging programmes in the East Midlands. Mentorship is available for non-medical/allied health professionals who are working in the NHS to develop their PhD proposals and NIHR fellowship applications.

Role shadowing: Staff are invited to gain experience of other roles to support personal and professional development as well as to strengthen collaboration and communication between individuals working in different areas or at differing levels of seniority. It is widely promoted via the newsletters, staff open days for staff at all levels and across all job families.

Support courses and workshops for grant writing: These are organised locally. SP workshops were reported to be very useful, with attendance of ~20 staff of all levels of seniority; plus staff organised (mini retreat) writing sessions, generally as weekly half day slots during term time. SM hosts grant writing workshops for all academic staff and postdoctoral researchers. Advice and support with impact and engagement is embedded within these events and complemented by additional impact training events.

Engagement and impact

Annual public engagement training sessions for staff and students are supported by impact and engagement champions. Funding is available for staff to attend public engagement courses. The intranet also provides public engagement resources, such as toolkit posters and scripts for popular activities, as well as evaluation form templates, to measure changes in knowledge and/or opinions.

A budget is available to support costs of travel and conference attendance. This encourages colleagues to seek opportunities to disseminate their work through attendance at relevant events

in the UK and internationally. Researchers can also apply for funding for research visits for collaboration or specific external training. The university Conference and Training Care Fund provides additional supports for staff attending conferences with (e.g.) childcare commitments.

2.2 Postgraduate research students

Postdoctoral degrees awarded

PGR data calculated as FTEs/academic year total 46.7 across UOA4, compared with a REF2014 average of 29.28. This reflects the vitality of our PGR environment and indicates sustainability of the pipeline of discipline-specific strengths across the UOA. These figures include vocational doctoral programmes which are classified as PGR: Educational Psychology (10-12/year) and Clinical Psychology (16/year). Our programmes offer doctoral level training in research methods, funded through competitive awards, e.g. by the Department of Education and HEE.

Within the unit, over the assessment period, 72% of doctoral awards (235) were to females. SP's Athena Swan action plan includes strategies to attract males into Psychology. Similar demographics in our DPAP professional doctorates have prompted plans to increase diversity. Part-time study for PGRs is offered proactively.

Building postgraduate research student capacity (sustainability and pipeline)

Our Masters programmes included Brain Imaging, Psychology Research Methods and Psychology Conversion, Developmental Psychopathology, Computational Neuroscience, Cognition and AI, Mental Health Research, Management Psychology, Occupational Psychology, Work and Organisational Psychology, Workplace Health and Wellbeing (Distance E-Learning).

19.7% of PGRs (by headcount) in the unit have been funded by the Research Councils (including through the institutional doctoral training centres and partnerships (ESRC, EPSRC and BBSRC and MRC Impact), CASE awards (ESRC, EPSRC and BBSRC). Others are supported by, NIHR, EU and other sources including charity and industry (e.g. Bial Foundation, Brain Tumour Charity, Defence Science & Technology Lab, Driving Standards Agency, Fight for Sight, Pain Relief Foundation, MS Society, Alzheimer's Society). SP also has an internal mechanism to recruit students to specific project areas and funds two studentships per year to support strategic initiatives within the school (e.g., to complement research grant awards). DPAP hosts the two EU funded Marie Sklodowska-Curie Innovative Training Networks (INDUCT and DISTINCT) including 30 funded PhDs across Europe with four of these early career fellowships based in DPAP.

Fostering research culture for PGRs

- High quality supervision: All PGR students have a primary supervisor and at least one additional supervisor. Supervisory teams support ECRs to develop expertise in supervision. Dedicated postgraduate tutors provide additional points of advice and support. A minimum of 10 formal supervision sessions per year are documented and held on file. Progression reviews by an independent internal assessor are used to assess and report on progress so that any issues with the quality or level of supervision can be remedied. Responsibility for students supported through the BBSRC and ESRC doctoral training programmes is held locally following the first year of lab rotations (BBSRC DTP) or other training (ESRC DTC/DTP).

- PGR student support: PGR students have access to academic and welfare support through a number of central or local channels; e.g. consultations with a locally-allocated postgraduate student advisor, access to a peer support groups and mentoring schemes, wellbeing and disability services and careers advice and development services. Maternity/paternity support is also provided by the UKRI doctoral training partnerships (but does not yet extend to all our vocational PhD programmes). Additional support during the pandemic has included IT provision for home use.

- Skills training: PGR students accrue credit for completing Researcher Academy training (REF5a;3.3) and any other training provided through their school or doctoral training

programme, e.g. workshops on conducting a systematic review and on qualitative and quantitative research.

- Networking opportunities: PGRs regularly attend and contribute to weekly internal seminar series, and present their work (in poster format as well as final year talks) at annual PGR days attended by post-docs and academic staff. PGR student representatives in DPAP organise bimonthly PGR seminars and monthly PGR-led discussion forums, as part of the divisional PGR community initiative framework intended to foster student-driven networking and knowledge and skills development opportunities. Additional opportunities to present are provided by our doctoral training programmes (the BBSRC DTP and the Nottingham ESRC DTC/ Midlands Researcher Academy DTP). Thus, a relatively high proportion of our students are also part of cross-school or cross-faculty networks.
- Research-friendly environment: PGRs are accommodated in spacious modern or refurbished offices, each with an individually allocated desk and lockable storage space. Students have use of kitchens, social spaces for informal gathering, bookable meeting and interview rooms. Part-time students have access to hot-desk facilities within designated rooms. State-of-the-art research equipment is provided locally (Section 3). Students also access the university platforms, e.g. for brain imaging and data storage, supported by allocations of scanning time and file space to support their training. For example, SP is allocated up to 36 hours of PGR scanning time and HPC access for student data requiring analysis pipelines.

2.3 How Nottingham UOA4 supports and promotes equality, diversity and inclusion

We have committed to promoting an environment embracing EDI for many years (REF5a;3.5).

SP has received and successfully retained Athena Swan Silver awards 2008-2020. Our self-assessment committee reconfigured with a wider EDI remit, reporting to the Faculty of Science EDI committee. SM achieved Athena Swan Bronze in 2013, and Silver in 2015, renewed 2019. The local EDI committees, responsible and accountable for all nine protected characteristics, comprise a spread of job families and levels, student and external representatives, report to termly staff meetings and use awaydays to raise awareness of EDI and to deliver training (e.g. implicit bias). New staff receive an EDI induction from a committee lead. Completion of EDI and unconscious bias training is monitored and refreshed every 3 years.

EDI features in Terms of Reference and is included as a standing item for all research committees and senior management groups to ensure all activities are considered with regard to impacts on protected characteristics/other diversities.

Evidence of delivery on our EDI agenda includes: EDI web and intranet pages, implementation of core meeting hours (9.30am-4pm), activities to promote visibility of women and understanding of protected characteristics (plasma image screen and portrait diversification; Inspiring Women displays); Athena Swan workshops; open flexible working for maternity/paternity benefit (e.g. 11 periods of parental leave were taken in SP); provision of breastfeeding rooms and fridges; additional gender-neutral toilet provision; improved access for wheelchair users.

The Maternity/Shared Parental Leave Planner was developed in consultation with staff as an Athena Swan initiative. The planner supports individuals and their managers when planning for (and during) the period of maternity/shared parental leave.

To overcome digital inclusivity challenges, we provide IT support to personalise devices, across the UOA, for students and staff alike, configuring individual devices to suit individual needs. Students are also encouraged to seek support from the university's Disability Support Services to inform decisions about reasonable adjustments required.

We are highly supportive of institutional initiatives for BAME staff including the 'Stellar HE' Leadership programme. In October 2019, the university hosted the 'BecoME BAME Leaders in Healthcare Conference' to highlight the journeys of BAME leaders in healthcare, to inspire future leaders in healthcare, from all professions. The conference was widely advertised across our UOA.

We piloted 'Diversity by Design' for a 2019 assistant professor recruitment; this changed the language used for advertisement and ensured inclusion of role-based criteria within the selection process.

2.4 EDI and the construction of the REF submission

The university supported employees to voluntarily declare relevant personal circumstances and their impact on volume of REF outputs (see REF5a;3.6). All researchers were asked to nominate any outputs they thought eligible for inclusion for REF2021 for our annual internal review process.

All staff involved in REF preparations completed bespoke masterclasses: REF, Equality, Diversity and Inclusion Training (covering EDI legislation and principles governing REF conduct, protected characteristics, unconscious bias, management strategies for positive outcomes).

To allow staff and research students without other funding to publish their research in the most appropriate journals (whilst satisfying the open access requirements for REF), internal funds supported gold open access publication in journals that lacked a suitable green alternative (in terms of embargo period). There was no competition for these funds, provided the research met the criteria of the REF2021 guidance.

All staff were encouraged to develop the impact of their research across the breadth of our diverse portfolio. Of the 7 projects put forward as ICSs 4 have lead authors who are women and 3 men (4 professors, 2 associate professors, 1 senior research fellow).

3: Income, infrastructure and facilities

3.1 Research income (1st August 2013 - 31st July 2020)

Average total research spend has increased by £1.55M per year: £4.94M/year in the present REF as compared with £3.39M/year in the previous REF cycle. Average total award is higher at £6.84M/year. Income sources for the period comprised: 32% UK research councils, 29% NIHR, 12.8% UK-based charities, 12.7% from other UK government bodies, and 5.4% from the EU. Industrial funding (4.5%) is strategically important for some of our applied areas of research outside the NHS remit (e.g. translational work with animals, see below). Proportion of income from other sources is presently low (<4%) and we aim to diversify our funding sources over the next period, also increasing funding for research in neurodiversity and other EDI lines of research. Research income-in-kind for the unit has totalled £6.2M, from NIHR, for MindTech.

The NIHR awards tend to be for large programmes of research and are not fully captured in the income figures because these grants, and the associated Research Capacity Funding, are typically submitted through our local NHS Trusts. Nonetheless, through our collaboration with the IMH, Research Capability Funding enhances DPAP's research capacity by contributing to sponsorship, governance, accommodation, financial management, and human resource management costs.

IMH received 57 grants from NIHR, in total £19.8M with staff as PI, and £67.25M with staff as co-applicants. 29 of these awards are worth more than £1M. Projects we led included: assessments for children with emotional difficulties (Sayal), cognitive rehabilitation for people with MS (das Nair), crisis teams use in dementia (Orrell), stimulant medication for ADHD and tics (Hollis, Sayal), TMS for the treatment of depression (Morriss, Liddle). Arcelus has secured over £3M funding since his appointment in 2016. Grants as co-applicants included: group intervention for postnatal depression in British mothers of South Asian origin (Morriss); enhancing return to work after trauma (das Nair).

The CLAHRC/ARC was awarded £11M (2014-2019) and £9M (2019-2024) to deliver a programme of world-class research and capacity building, working closely with its 60 partners across the NHS, local universities, local government, industry and the voluntary sector who have contributed £18M matched funding.

MindTech (Hollis) was awarded a further £1.3M in 2018, leading to the NIHR Nottingham BRC Mental Health and Technology Theme (£3.75M; 2017–2020). MindTech has leveraged >£109M (ratio >40:1) in grant funding, with >80 projects recruiting >14,000 participants including major trials of digital technology for mental health (£1.7M NIHR funding).

The Nottingham MS Research Group (based within Clinical Neuropsychology; das Nair) secured a £1.85M NIHR grant for neuropsychological evaluation and rehabilitation in MS. In total, Clinical Neuropsychology has secured over £9M in funding from NIHR.

The Cochrane Schizophrenia Group has been funded continuously with further funding of £875K in 2020 providing support for the next 5 years.

The AQUEDUCT research programme (£2M; Centre for Dementia) aims to reduce hospital admissions through improving the effectiveness of crisis teams. The PRIDE ESRC/NIHR research programme (£2.9M) has developed a self-management programme for people with dementia to enable them to remain independent for longer.

Other major IMH grants include INDUCT and DISTINCT, two EU Marie-Curie Networks (£7M) comprising 30 PhD students based across the EU on research training projects in dementia care and technology. The Centre for Dementia is a partner with the University of Worcester in the Alzheimer's Society funded TAnDem Doctoral Training Centre, which established 8 studentships.

Individual PIs and small groups of investigators working in basic science have been supported by diverse funding sources, including charitable foundations (and smaller grant schemes for relatively inexpensive areas of research). Awards to support our core areas of research have come from Action Medical Research, Alzheimer's Research UK, BBSRC, EPSRC, ESRC, MRC, the Wellcome Trust, Leverhulme and Horizon 2020. We have been further supported by Arthritis Research UK, Autistica, the Bial Foundation, Chan Zuckerberg Initiative, Department for Transport, Deutsche Forschungsgemeinschaft, Education Endowment Foundation, Fight for Sight, International Society for Autism Research, Jaguar Land Rover, Macular Society, Newton Fund, MS society, Stroke Association, Templeton Foundation, Tourettes Action, Tourette Association of America, VSO and the Waterloo Foundation. We have also had success with KTPs (with Cambridge Cognition and the Together Agency) and industrial sponsorship (e.g. for BBSRC-DTP awards) as well as NHS funding streams.

Highlight outcomes included:

- evidence for new links between the rate of occurrence of fixational eye movements and the detectability of visual targets (Proc Roy Soc B; IOVS, J Neurophys) translated to the development of new methods for objectively measuring visual capacity in patients (Visual Neuroscience group £641K; Wellcome Trust fellowship and Fight for Sight);
- research identifying digital manipulations that enhance peripheral visual function (Roach £76K; Fight for Sight) is now being used to develop assistive technology for patients with late-stage macular disease (McGraw £176K; Macular Society);
- a comprehensive evidence base for the effectiveness of technology to support the acquisition of basic literacy and numeracy skills in marginalised children in Malawi and the UK (Pitchford £637K; VSO and EEF; plus an ESRC-funded PhD studentship);
- an evidence-based information leaflet to enable safe conversations about self-harm has been taken up by NHS guidelines online, as a recommended resource for supporting people who self-harm (Townsend; £475K Listen-up NIHR funding);
- individualised risk assessments: evidence-based on sexuality and sexual behaviour for UK blood donors; following 80,000 donor surveys (Ferguson £70K; UKFORUM);
- involvement in the ESRC-funded project STEMM-CHANGE, to drive positive change in EDI culture and practices (Wilding; CI and Programme Director).

Pump priming is a key component of our research pipeline and was supported by learned society small grants, as well as awards administered by the university. 7 EPS and 5 British Academy awards have fostered later success with more substantial applications (e.g. to ESRC and BBSRC). We have also developed our research with 7 MRC Confidence in Concept awards and institutional investment, e.g. from the university's Research Priority Area funding streams (total £108.9K), the Interdisciplinary Centre for Analytical Science (£14.8K) and the Nottingham Digital Economy Hub (£97K).

Highlight outcomes included:

- Experiments funded by an EPS small grant led to a successful ESRC DTC award (£27.6K) and publications in QJEP and J Exp Psychol (Haselgrove; £2.5K).
- MRC Confidence in Concept (Roach; £88K) was used for the development of new 'oculometric' methods for objectively measuring visual sensitivity from changes in fixational eye movements (leading to £113K from Fight for Sight).

Hearing Research has been primarily supported by core funding from NIHR BRC (Hall, Kitterick) and MRC programmes (Akeroyd, Krumbholz) supplemented by grants from Technology Strategy Board (Hall), MRC (Hall, Hartley), EU (Hartley, Hall), NIHR (Hall, Hoare, Kitterick) and EPSRC (Akeroyd) plus many charity and industry awards.

Research in PPN has established and characterised rodent models of CNS disorders to validate 5-hydroxytryptamine receptors as therapeutic drug targets (Fone; £30.5K industry funding). Funding from the NC3Rs has expanded our capacity in this area, with grants awarded for innovations in refinement of in vivo methods for stroke assessment and multielectrode recording from spinal cord (Trueman, Hathway).

3.2 Infrastructure and facilities

Each research group has its own research facilities. SP and DCN have buildings on University Park and other neuroscience labs are based in the Medical School. All buildings have received continual investment from the university and other sources, to maintain and update experimental equipment.

Most DPAP staff are located in the award-winning IMH building. It has outstanding office space, sound-proofed laboratory facilities, participant reception area, dedicated interview rooms and conference facilities, kitchens and social spaces, and an art gallery space which enables art-based research into mental health and public engagement. Both DPAP and SP resource psychometrics test libraries open to all staff and students.

SP has well-established human experimental labs and maintained facilities for computer-based, eye-tracking, EEG and TMS studies, plus the anechoic chamber, driving simulator and 'Toddler lab', supported by 5 in-house technical and IT staff. A further investment of £200K enabled refurbishment of 121.5m^2 (furnished offices and three testing rooms, break out/meeting area and small kitchen for Computational Neuroscience), a new face lab provisioned with specialist equipment for capturing moving faces, manipulating the images, and a 55m^2 EEG memory lab and refurbishment of seminar rooms for lab groups and meetings (redecorated, new furniture, new computers, white boards, new projectors). Both of the new labs were resourced by a university £30-50K equipment start-up allowance. We match-funded specialist equipment aligned with a grant award (total value ~£60K). SP 'Social Space' refurbishment included new furniture, kitchenette and computers, providing a spacious informal setting used for career development lunches; promotions workshops and ECR events. Disabled access improvements included upgrades to access lifts, toilets and lab entrances. New gender-neutral toilet and parenting room provision (and signage) have been priorities for all of our buildings.

SP invested in 130m^2 bespoke laboratory space in the university Bio-Support Unit for the Behavioural Neuroscience group (for research supported by two BBSRC grants, an MRC award and industrial sponsors). PPN neuroscientists also use the Bio-Support Unit (192m^2 behavioural suite and surgery). In addition, we can all access small animal (11.7T) imaging facilities. Shared infra-structure platforms facilitate collaborations (co-supervised PGRs, joint grants and

publications) including SP (Bast, Bonardi, Cassaday, Moran) and PPN (Hathaway, Fone, Pardon). Two PPN technicians support the use of these facilities, as an inclusive package when SP staff rent the PPN surgery and behaviour rooms.

Hearing research benefits from bespoke auditory laboratories and equipment continually refined for 40 years at University Park, Ropewalk House (NHS Audiology) Nottingham, and a 'Scottish Section' at the Glasgow Royal Infirmary. Major investments include a loudspeaker laboratory for spatial-hearing experiments (£100K MRC Capital Funds; £48K university), paired eye-trackers for tracking people while they converse (£110K MRC Capital Funds) and a fNIRS system (£263K, MRC Clinical Research Infrastructure).

Staff across the unit benefit from institutional investments, for example the new library and digital infrastructure (including the Research Information System which supports the delivery of open access, open science and research data management). The new HPC facility supports projects requiring large-scale data processing, such as neuroimaging and electrophysiology, including the large-scale processing of data from repositories for secondary analyses. We benefitted from 227,674.75 CPU hours (2018-2020).The university has invested over £3.8M in its digital research programme since 2016.

Increased PGR numbers have been supported by institutional investment over the period. New/newly-refurbished Graduate Centres exclusively for PGRs are positioned on all campuses. These provide bookable seminar rooms, computers, career libraries, kitchen facilities, lounge and relaxation areas. The £18M 2014 refurbishment of the George Green Library provided further bookable individual and group PGR study areas.

The university's Strategic Development Fund attracted significant investment for the Nottingham Clinical Trials Unit (NCTU). Large-scale NIHR trials (e.g. STADIA, SATURN, CRAMMS, ReMemBrIn) were developed and supported through collaboration with NCTU. NCTU has provided popular clinical trials courses and a Clinical Trials Database Support service to assist database design and data management and training in use of software, and REDcap database software and support is available. Projects such as NEuRoMS from DPAP are using such software. The unit is also supported by the £5.1M NIHR-funded East Midlands RDS (Orrell was co-applicant), providing high quality methodology and funding advice for applied health research. Applicants are signposted to RDS when developing proposals.

UOA4 researchers utilise world-leading facilities for basic and clinical studies of cognitive function and neurological diseases within the Sir Peter Mansfield Imaging Centre. The university's Research Vision awarded a £1.5M Beacon investment in Precision Imaging, including two new MRI scanners and major upgrades to existing scanners. The university is an international leader in establishing a platform for large-scale multi-centre clinical work in UHF 7T MRI and spectroscopy. 27 of us are members of the Beacon and we are well-represented on the management board (Jackson, Liddle, Krumbholtz, Kitterick, Chappell and Sotiropoulos). Jackson is the programme lead for brain plasticity and neuromodulation. Chappell was a Beacon-specific appointment as Chair of Biomedical Imaging. We have two Beacon-funded fellows, six PGR students, plus other Beacon-funded ECRs.

Unit involvement in the BRC is increasing. Hollis is the programme lead for the Mental Health and Technology group. Jackson and Liddle lead on Neuroimaging and the Neuromodulation programme and four of our members are BRC group (Hall, Hartley and Hoare) or theme (Kitterick) leaders. We also have a BRC-funded fellow and PGR.

New SM posts included a Research Excellence Manager, Research Development Manager, and part-time Translational Business Development Manager with strong ties to NHS Trusts, to focus on translational research and promote industrial collaboration and commercialisation (working with Intellectual Property leads).

3.3 Enabling impact

We have a variety of mechanisms to promote impact, such as pump-priming funds to support activities likely to lead to research impact, and an ongoing programme of impact training and showcase events. Since November 2018, we have been supported by Faculty Impact Officers (working closely with the impact champions).

Impact is central theme of research awaydays, and embedded with regular Impact Case slots within our internal seminar series. The work of the SP Engagement Committee is supported by an annual allowance of £2500 (from the school budget). Six staff completed the university Impact Leaders Programme with a variety of external partners (Cambridge Cognition, VSO International, Jaguar Land Rover, Driver and Vehicle Standards Agency, Relate and Nottinghamshire Police).

Nottingham's ESRC IAA supported:

- Ferguson (2019) seminar on new selection and recruitment in the healthcare professions;
- Ropar (2018) an online training package (relating to the detention of autistic individuals) for Nottinghamshire Police: a PhD student was shortlisted for 2019 ESRC Celebrating Impact Prize;
- Blackie (2018) to develop a therapeutic tool with Relate Nottinghamshire;
- Allen (2017) scoping study with Jaguar Land Rover to explore how changing vehicle use and design can increase mobility;
- Chapman (2017) seminar series and networking event with the DVSA;
- Pitchford (2016) to develop integrated data handling protocols for sustainable early child development and wellbeing in Malawi with VSO International;
- Moran (2015) for a 'Healthy Brains' public event with Cambridge Cognition;
- Cragg, Einav & Ropar (2015) to develop new activities for Summer Scientist Week and accelerate the impact of child development research on families.

Notably, we have also been supported by the Institute for Policy and Engagement, from its launch in 2018, with Pitchford and Chapman's research both featured at the external launch (2019), and researchers in SP (Ropar, Cassidy and Pitchford) and DPAP (das Nair) awarded small grants to develop policy impact. Other support for impact included 4 Small Steps Awards (£8,241), 2 International Collaboration Fund awards (£12,000) and 3 ESRC collaborative PhD studentships (e.g, with onebillion).

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

4.1 Cross disciplinary collaborations

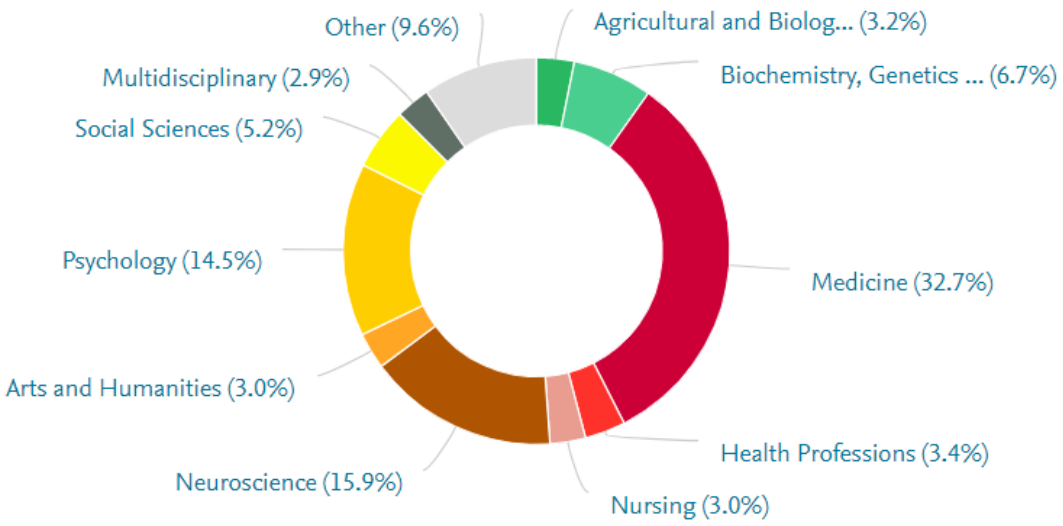

Figure 1 – Publications (2014-2020; by Cat A staff) by subject area (SciVal).

Data from SciVal (Figure 1) confirms that cross-disciplinary working is embedded in this cross-faculty UOA. Below are some selected highlights:

- Ferguson is part of a project on energy efficiency in the workplace in collaboration with colleagues in Nottingham Computer Science, Southampton University and UCL (RCUK Digital Economy; £1.3M).
- Blackie led on grants from the Templeton Religion Trust, which include collaboration with Ford University Philosophy ($206,463; on adversity and wisdom).
- Hollis leads a project with the Karolinska Institute, on remotely delivered behavioural intervention for children with Tourette Syndrome (NIHR HTA; £1.56M), and collaborates with the University of Auckland, on 'Adolescent Mental Health and Development in the Digital World' (MRC Engagement Award; £100K).
- Orrell coordinates three interdisciplinary networks for dementia with national and international organisations: Innovation Network in Dementia Using Current Technology; Dementia Inter-sectorial Strategy for Training- Innovation Network for Current Technology; and Promoting Independence in Dementia. For example, the first of these involves UCL, University of Hertfordshire, Maastricht University, Vrije University Medical Centre, Vrije University Brussels, Karolinska Institute, Czech Technical University in Prague, WHO, Alzheimer Europe, Alzheimer Disease International, University of Witten, World Federation of Occupational Therapists, Eumedianet, Beawerk, INTRAS, Geronto Centrum, Saxion University and SilverFit (total £10.5M).

4.2 Inter-institutional/international collaborations

Many of our cross-disciplinary collaborations are also inter-institutional and/or international (e.g. Blackie, Hollis, Morriss, Orrell). 41.2% of our output is the product of international and 40.8% national collaboration (SciVal). Nationally, our top 5 collaborating institutions (based on numbers of co-authored papers) are University of Oxford, UCL, KCL, University of Cambridge and Newcastle University. Below are selected highlights, including examples of our international collaborations.

- Daley: Development and implementation of an evidence-based behavioural intervention for ADHD. This has led to increased intervention training in the UK, a national roll out of the intervention in Denmark, and additional parenting training in Asia.
- Dening: EU-funded Mindful Design for People with Dementia programme which involves 6 countries (co-applicant).
- Ferguson: held a series of international collaborations on blood donor motivations with 10 other institutions (e.g. Eszterházy Károly University, Ohio University, University of New South Wales, University of Queensland).
- Hollis: member of the oversight committee for the NIHR Mental Health Transnational Research Collaboration.
- Glazebrook: collaboration with the Universities of Zambia, and recently funded with the University of Malawi and an enterprise group to produce COVID-19 health education materials.
- S Jackson: led BIGTIC, bringing together clinical and non-clinical scientists from the UK and France with Washington University in St Louis and UCLA; led the European Research Network Programme Investigating Human Sensorimotor Function in Health and Disease.
- Lawrence: Nottingham lead for the Imagen Consortium which included the Central Institute of Mental Health Mannheim, Dresden University of Technology, University of Paris-Saclay, Paris-Sud University. This resulted in over 20 publications, including in Biological Psychiatry, Molecular Psychiatry and Nature.
- Morriss: member of EU Horizon2020-funded RADAR-CNS consortium led by King's College London, involving 24 other industry companies and organisations from Germany, Spain, Denmark, Belgium, Netherlands, Italy and United States, and spanning neurology (epilepsy, MS), computer science, pharmaceutical industry, digital industry.

- Pitchford: led a project on the use of tablet technology to improve teaching and learning, partnered with the University of Malawi, co-funded by a Hermes Fellowship (HEIF) and VSO.
- Townsend: led the Global Suicide Prevention Research Hub (with Sayal and others), partnering with University of Guyana, University of Ghana, National University of Malaysia, UNNC and Hong Kong University.

4.3 Contributions to the research base

Prestigious externally funded Fellowships

Amongst our ECRs, Cassidy held an ESRC Future Leaders Fellowship and Roach held a Wellcome Trust Research Career Development Fellowship. Reid held a Radboud Excellence Initiative Fellowship at Radboud University Nijmegen. Other fellowship awards were from the BIAL Foundation, Faculty of Occupational Medicine, Health Service Journal Innovation Award, the British Science Association, Royal Society for Public Health and International Society for Research on Aggression.

Awards and prizes

Our staff have received national and international recognition including the following highlights: BPS Margaret Donaldson Early Career Prize (Cragg); National Autistic Society's Autism Professionals Awards, in the most impactful researcher category (Cassidy); NIHR Senior investigator awards (Hollis, Morriss, Orrell); Association for Psychological Science Rising Star award (Madan); Young Psychiatrist Award, World Psychiatric Associaion (Katshu). We were also part of an international initiative which was a joint winner of the 2019 Global Learning XPRIZE (Pitchford with onebillion).

Invited/keynote lectures and conference organisation

Arcelus: invited plenary speaker at the International Conference of the Academy of Eating Disorders and keynote speaker at the Nordic Association for Clinical Sexology.

Burdett: invited lectures at the Max Planck Institute for Evolutionary Anthropology, Leipzig and at the Universidad Austral, Buenos Aires.

Das Nair: invited keynote speaker at MS Ireland, Portuguese MS Study Group Meeting, European Rehabilitation in MS, and the Australasian Society for the Study of Brain Impairment.

Haselgrove: plenary speaker at the International Spanish Society for Comparative Psychology, University of Oviedo and gave an invited talk at Waseda University, Japan.

Hollis: keynote speaker at the NHS Research Scotland Mental Health Annual meeting, and gave an invited public lecture (Auckland).

S Jackson: invited speaker at the Federation of European Societies of Neuropsychology and the British Association for Cognitive Neuroscience Annual Meeting.

Orrell: plenary speaker at the 2nd International CST, University of Hong Kong, 3rd International CST conference, St Louis University, and at the Alzheimers Europe and Alzheimers Disease annual conferences.

Schröder: plenary speaker at the 5th International Conference of the Compassionate Mind Foundation.

Pardon: invited speaker at the 5th International Symposium on Thymosins in Health and Diseases.

Pitchford: invited talks sponsored by the British Neuro-Oncology Society, International Conference on Educational Neuroscience, Lesbos Dialogues, Posterior Fossa Society, Swedish Neuropsychological Society and UNESCO.

Conference committee memberships have included the European College of NeuroPsychopharmacology (Moran), European Professional Association of Transgender Health (Arcelus), the European Symposium on Suicide and Suicidal Behaviour (Townsend), and the

Society of Occupational Medicine (Griffiths). Trueman was co-founder of the Biennial UK Preclinical Stroke Symposium.

Invited professorships and fellowships

Internationally, S Jackson holds the Dirk Bakker Visiting Professorship at Utrecht University and Townsend holds the University of Melbourne Miegunyah Distinguished Visiting Fellowship. Mitchell was elected as fellow of the Royal Society of Arts and of the BPS. Humphries holds honorary research fellowships at the University of Sheffield and the University of Manchester. Ison is an honorary clinical research fellow at King's College Hospital where he established one of the first single-neuron recording facilities in the world. Leka was Distinguished Research Scholar at the University of South Australia. Das Nair held a Distinguished Visiting Scholarship at the University of Technology, Sydney.

Membership of funding body/peer review college assessment and strategy panels

Mitchell was chair of the ESRC grant assessment panel and a member of the ESRC grant delivery group. Townsend served as ESRC large grant panel member. We have served as members of the ESRC Peer Review College (Allen, Filik, Lawrence) and panel members for the Wellcome Trust Basic Science Fellowships (Wilding) and Sir Henry Dale Fellowships (S Jackson). Strategy panel memberships included BBSRC Bioscience for Health (Cassaday) and Skills and Career Development (Wilding). We sat on NIHR grant panels (Hollis, das Nair, Morriss, Orrell). Hollis was a member of the Technology Strategy Board for Digital Health and das Nair for the UK Occupational Therapy Research Foundation.

Memberships of national and international advisory boards/Provision of expert advice

We have served on a range of advisory boards, including the Alzheimer Society (Orrell), Arthritis Research UK Pain Centre (Bast), Bernstein Centre Munich (van Rossum), Work Safe Canada (Leka), Imagine Worldwide (Pitchford), Federation of European Societies for Neuropsychology (Jackson), Research Council of Norway (Sayal) and the Swedish Research Council (Leka).

Cassidy served as an expert witness for Coroner inquests (understanding the role of autism in those who died by suicide). Das Nair was a mentor for HEE. Ferguson was a working party group member reporting to SaBTO, to recommend change to blood donor deferral criteria in the UK, and expert panel member for NHS Blood and Transplant to review the effectiveness of recruitment campaigns for BAME blood donors. In addition to a portfolio of local work (e.g. for Nottingham City and the Nottinghamshire Healthcare Trust), Hollis chaired the NICE guidelines for Psychosis and Schizophrenia in young people, and advised the Cabinet Office on digital technology for mental health. Morriss chaired the NICE Guideline Development Group and joined NICE Panel of Experts. Townsend was a member of expert reference groups for the Self-Harm & Suicide Prevention Competence Framework (children, young people and adult), the BPS Expert Panel on the Psychology of Suicidal Behaviour and acted as consultant for Public Health England's 'Local suicide planning: A practical resource'. Lawrence was a member of the UK National Partnership on Work-Related Violence. We have also acted as advisors to the UK Ministry of Defence Science and Technology Laboratory (Haselgrove, S Jackson).

We further support the research community by volunteering our services as members of Health Research Authority Research Ethics Committees (das Nair), Trial Steering and Data Monitoring Committees (das Nair, Sayal). Gibson is a Non-Executive Director of the Leicestershire Partnership NHS Trust.

Staff working with animals also promote best practice nationally. Gibson and Trueman were working group members for the NC3Rs Experimental Stroke Models and contributed to the IMPROVE guidelines for in vivo stroke research. Moran was on the steering panel for the Laboratory Animal Science Association publication Guiding Principles for Behavioural Laboratory Animal Science.

Learned society committee roles

Reflecting our interdisciplinary breadth we supported a diverse range of learned societies through officer roles within the *Applied Vision Association* (Allen, Treasurer), *British Association for Cognitive Neuroscience* (S Jackson, President), *British Association for Psychopharmacology*

(Moran, Non-Clinical External Affairs), *British Society of Audiology* (Hoare, President; Akeroyd, Trustee, Journal Chair) *European Association of Geriatric Psychiatry* (Orrell, President), *European Professional Association of Transgender Health* (Arcelus, Co-Chair of Global Guidelines), *Experimental Psychology Society* (Cassaday, Honorary Secretary), *Federation of European Societies for Neuropsychology* (S Jackson, Scientific Advisory Board member), S*ociety for Psychotherapy Research* (Schröder), International Vice-president), the *British Association for Psychopharmacology* (Fone, President Elect; King, Council Member), *European Society for Molecular Imaging* (Farr, Chair), *International Society for Cerebral Blood Flow and Metabolism* (Farr, ECR and Program Committee roles) and *The International Society for Serotonin Research* (Fone, President). Staff have also served as committee members, e.g. on the *Academy of Social Sciences* (Griffiths)*, British Association for Cognitive Neuroscience* (Allen), *British Neuropsychological Society* (Pitchford), *British Psychological Society* Research Board (Cassaday, Mitchell) and Ethics Committee (Cassaday), *British Science Association* (Allen) *Experimental Psychology Society* (Filik, Haselgrove), *International Association of Suicide Prevention* (Townsend), and the *Royal College of Psychiatrists (*Hollis).

Journal editorships

Staff held over 30 roles as Editor, Deputy Editor or Associate Editor, making further contributions as Action, Section, Review or Guest Editors, and/or Editorial Board members to over 60 different journals. These include prominent open access and open science journals (*Royal Society Open Science*, *Cortex*, *Frontiers* and *PLOS* journals) which make adherence to transparency and openness a requirement for publication. Chief/Deputy editorial roles included *Aging and Mental Health* (Orrell), *Autism in Adulthood* (Cassidy), *Child and Adolescent Mental Health* (Sayal), *Journal of Child Psychology and Psychiatry* (Hollis), and *Journal of Neuropsychology* (S Jackson). Associate editor roles (total 24) include *Cortex* (S Jackson, Wilding), *International Journal of Audiology* (Hall), *International Journal of Transgenderism* (Arcelus), *Journal of Cognitive Psychology* (Filik), *Journal of Experimental Psychology: Animal Learning and Cognition* (Bonardi), *Quarterly Journal of Experimental Psychology* (Cassaday, Haselgrove), *Trends in Hearing* (Akeroyd).

4.4 Contribution to the economy

SciVal analysis for the period of assessment shows a count of 17 patents citing UOA4 scholarly output.

MindTech, in partnership with over 200 companies, helped industry to secure more than £6M in grants. The majority of activity is with SMEs and cuts across a range of sectors including Pharma, MedTech, Life Sciences, Digital and the Creative Industries. Key partnerships include:

- Brain+ ApS (Danish SME): focused on the use of brain training technologies for pre-symptomatic detection and prevention of dementia (also with Alzheimer Europe).
- OxfordVR (gameChange project; NIHR i4i Grand Challenge on Mental Health): exploring use of virtual reality to help adults with psychosis.
- Xenzone: successful SBRI phase 1 application to develop a new peer-support service within their Kooth digital mental health service; development and implementation of a new ‘opt-in’ consent system for Kooth’s user data.
- Magstim: NIHR EME grant (BRIGhTMIND) to evaluate TMS for treatment-resistant depression.
- QbTech: assessment and management of ADHD and has resulted in a number of successful funding applications (e.g., AQUA - NIHR CLAHRC EM, £300K; QUOTA - NIHR RfPB, £250K). We partner with EMAHSN on national adoption of the technology.
- BfB Labs: school-based evaluation of a new game to treat anxiety in children (Innovate UK Digital Health Catalyst; NHS England - SBRI Phase 1, £100K).

- Alpha-Stim: trials within Nottinghamshire Healthcare Trust to evaluate their cranial stimulation device for generalised anxiety disorder in adults (now adopted by the trust and we are exploring use for depression).
- ProReal: Avatar programme developed in partnership (NHS England - SBRI Phase 1, £100K; SBRI Phase 2, £1M) and now used in a number of NHS trusts for the treatment of borderline personality disorder (adults) and emotional difficulties (young people).
- P1vital: EU-funded PReDicT clinical trial has recently completed recruitment (913 participants across Europe).

SP is increasing engagement with industry. Research in Visual Neuroscience has helped develop new binocular approaches to treating amblyopia (lazy eye) in children. The development of a new device was supported by a Wellcome Trust fellowship (Roach) and an i4i award from NIHR (£153K). A multi-site RCT has been completed alongside regulatory approval. The device will now be further developed and marketed by a newly formed company called Kids Love To See. SP also had PhD training partnerships with a number of pharmaceutical companies, including b-neuro, Boehringer Ingelheim, Hoffman-LaRoche, Neuro-Bio (Bast, Moran).

Hearing research on the cost-effectiveness of cochlear implants (Kitterick) has informed a change in NICE guidance on cochlear implants; questionnaires (Akeroyd) are now routinely used by the major international hearing-aid and cochlear-implant companies developing new devices.

PPN partnered with multiple pharmaceutical companies, including Roche, Esteve, Servier, Shire, Proximagen, Forest Laboratories, GSK, to establish and characterise rodent models of CNS disorders. These were instrumental in validating several therapeutic drug targets to treat learning and memory dysfunction in humans (Fone, King). Pardon led on knowledge exchange awards (MRC Proximity) for drug discovery projects, with Eisai, Astex Pharmaceuticals and RegenRex Biopharmaceutical, to investigate the therapeutic potential of Thymosin β4 for neurodegenerative diseases.

4.5 Contribution to society

We have engagement committees and academic leads who support outreach and knowledge exchange activities and keep a rolling record of public engagement activities. Staff and their postgraduate students volunteer annually to present at established Festival of Science and Curiosity (February) and BSA Science in the Park (March) events. We also volunteer for Wonder and Mayfest (community events held at the University Park Campus May/June), Nottingham Potential and Sutton Trust Summer Schools (June/July). Widening participation initiatives include taster sessions for Year 10 school students, and placements for PGR Educational Psychology cohorts (10-12/year) in a range of schools to make sustained contributions to knowledge exchange in educational settings.

Our annual Summer Scientist Week engaged children in fun science activities: posters and information leaflets about our research were sent out to families, to encourage children (aged 4-11 years) to take part in research studies and psychology-themed games. Families received a follow up newsletter and provide feedback. This attracted a high proportion of repeat visitors, resulting in longevity of the research connections and a growing family of research participants. Other universities now run similar events based on the Nottingham model (e.g. Oxford, Plymouth). Summer Scientist Week was shortlisted for the Hoop Awards 2019 in the ‘Best for Learning’ category – recognising and celebrating family activity organisers who go ‘above and beyond’ to entertain, educate and inspire children worldwide.

Silver Scientist, a one-day engagement event specifically aimed at older adults and senior citizens took place for the first time in 2019 and was scheduled as a two-day event in July 2020 but cancelled due to Covid-19. Summer Scientist 2020 was successfully adapted to run virtually.

Pint of Science contributions included Moran’s ‘Mental Health and Me’ and ‘Bells and Smells predicting psychosis before the symptoms’ (2019), Sheppard and das Nair’s ‘Imagining the invisible: Dealing with invisible symptoms of MS’ (2018), and ‘Pour your own drink demo’ (Jones, 2018).

Café Connect (Wellcome Trust People Award) was a finalist in the University Knowledge Exchange and Impact Awards 2016. Uniquely, Café Connect involved all stages of the research lifecycle: public interaction and engagement, exchange of research ideas, promoted participation across a range of research topics, data collection and dissemination of results. Café Connect supported the development of the bids for a Youth Digital Mental Health Research Centre (Hollis, Townsend).

MindTech holds an annual national symposium bringing together 200-250 members of the public, mental health services users, clinicans, researchers and industry developers.

National self-harm data were harnessed for suicide prevention research via engagement with the Interagency Autism Coordinating Committee (IACC). IACC advises the US government on autism-related policy. To date, over 650 autistic people and their allies have completed the online consultation, for an INSAR policy brief ranking the top 10 research and policy priorities to prevent suicide in autistic people (Cassidy).

Working with Nottinghamshire police the Nottingham Impact Fellowship scheme funded work on the best ways to support autistic individuals in police custody, including a training video and toolkit (Ropar).

Townsend has worked to transform clinical practice for self-harm, through the uptake of a therapeutic assessment (card-sorting task) and delivery of expert testimony and NHS training.

Ferguson, working with the Australian Red Cross, has developed a warm-glow marketing tool to enhance the retention rate for first time blood donors.

Cragg was involved in developing the content for an open resource to improve numeracy (PReterm Infants' Skills in Mathematics). Since its release in May 2019, this resource has been accessed from 58 countries by 12,641 users: teachers (41%), educational psychologists (5%), other educational professionals (19%), health professionals (13%), academics/researchers (2%) and parents (20%), with 97% users reporting that that they would recommend this resource to others.

We collaborate with colleagues from the NHS, e.g. organising research days to bring together people with MS and their families to hear about the latest research (planned, in progress, or findings). We have a strong focus on PPI in research using NIHR INVOLVE and McPin Foundation definitions: people with and without lived-experience of mental health problems (or other relevant health issues) are actively involved in research. We take a multi-level approach to involvement at a strategic-level, e.g. inclusion of PPI volunteers at steering, strategy and operational group meetings and within research groups and projects. We foster a culture where our involvement volunteers are ‘part of the team’, their contribution valued, and its impact understood. Many of our clinically-focused PhD students pitch their ideas to PPI groups for feedback, which informs their project protocols. We engender PPI within all levels of our clinical research, providing expenses and offer a fee for involvement activities, with policies for these processes. We provide volunteers with training and development opportunities. A key feature of our approach is shared leadership of PPI, including staff with personal lived-experience of mental health difficulties.

PPI was at the heart of the James Lind Alliance Priority Setting Partnership (PSP) on Digital Technology for Mental Health (led by MindTech). PPI involvement was key to communicating and engaging with people with lived-experience across the country in the prioritisation exercise, involving surveys, discussions over social media and YouTube video production. The PSP involved 1200 people who contributed 1500 questions. Our subsequent 2018 Lancet Psychiatry paper exemplifies our track record of co-authoring academic papers with people with lived experience.