Institution: University of Northumbria at Newcastle

Unit of Assessment: UoA 4 Psychology, Psychiatry and Neuroscience

1. Unit context and structure, research and impact strategy

The current research position and key developments since REF2014

Our submission reflects the work taking place across the three research groups and three specialist laboratories or research centres (see Figure 1) within the Department of Psychology. In REF2014, 55% of our research was rated as 3* and above and the submitted work was notable for its impact, with 73% of the impact submission scoring 4*.

Since then, Northumbria articulated an overarching ambition for significant research growth, with a corresponding vision for Psychology to *become internationally recognised as an inclusive and diverse centre for innovative and rigorous research that informs teaching and creates impact for individuals, families, communities, organisations and society at large*. In achieving this vision, the unit submission has more than trebled in size: in 2014 we submitted 19 FTE, in contrast to **62 FTE** returned here, with an improved gender balance.

Research output in this period improved both in quality, with **61% in top quartile journals** (by SNIP Source Normalised Index per Paper) and in quantity of outputs, with **922 peer reviewed journal articles** published in the current REF period as against 316 published during 2008-2013. The rate and size of research grant applications made and won also improved. For example, **72 applications were made in 2019/20**, with a total value of **£14,449K**, compared with 29 applications made in 2013/14, with a total value of £2,888K. **Awards won in 2019/20 totalled £1007K**, as compared with £466K in 2013/14 and a notable success in 2020 was an ESRC (Digital Economy) award of £3.8 million for the **Centre for Digital Citizens,** which includes a (psychology-led) award of £1.7 million to Northumbria.

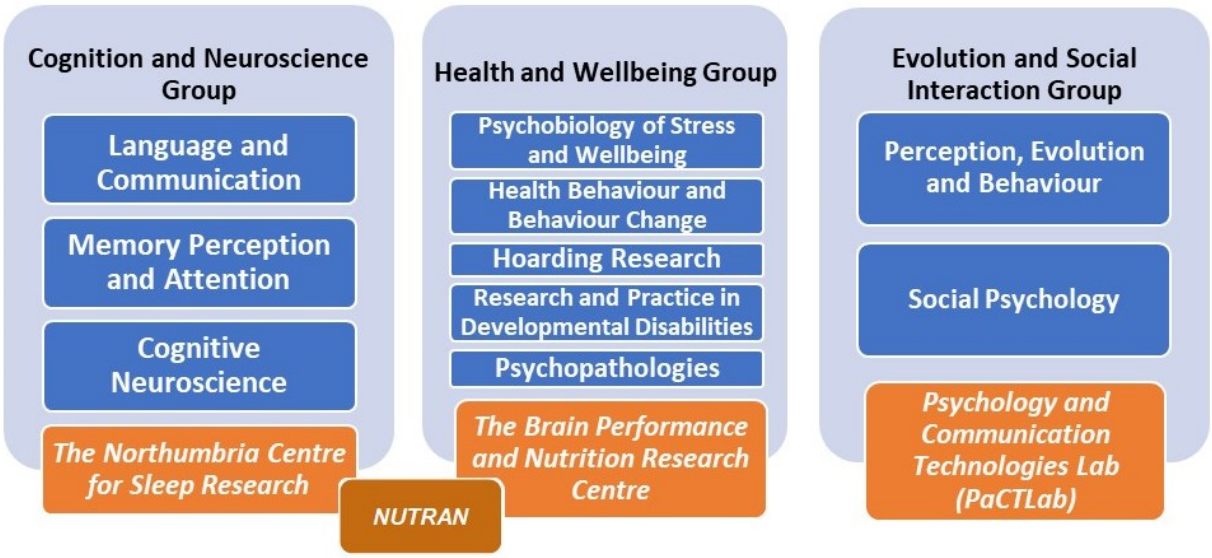

Figure 1: *The three research groups and associated specialist centres/laboratories*

Psychology returned three 'core' research groups in REF2014 and articulated a strategy to drive new research through these groups and through three dedicated research centres. The current position is shown in Figure 1, still with three core groups, which have all grown significantly. Our three smaller, but highly focussed and distinctive research laboratories/centres were returned to REF2014, although at that time the work of the Brain Performance and Nutrition Research Centre (BPNRC) was submitted under UoA3 and the work of the Psychology and Communication Technology Lab (PaCTLab) was submitted under UoA34. As a new development, to enhance translational, interdisciplinary work, both the BPNRC and the Northumbria Centre for Sleep Research now form part of **NUTRAN,** an interdisciplinary nutrition-focussed clinical trials unit which integrates expertise in trial design and delivery with biochemical, molecular, vascular and neuroscience analyses. NUTRAN offers targeted industry support via consultancy, basic scientific discovery and randomised clinical trials services. (https://www.northumbria.ac.uk/business-services/engage-with-us/research/NUTRAN/).

Achieving our strategic goals

The research growth aligns with the wider university **'Power with Quality' strategy** (REF5 section 2.1.1) and reflects the UoA4 strategy articulated for REF2014. Specifically we have delivered on plans to improve the research capacity of existing staff, to recruit new talent to each of our research groups and to improve translational, interdisciplinary research - by the introduction of NUTRAN, by targeting larger, interdisciplinary funding opportunities (resulting in four interdisciplinary Horizon 2020 projects and the new Centre for Digital Citizens) and by linking the research in psychology to cross-cutting **multidisciplinary research themes** (MDRTs) established across the University. These MDRTs promote the delivery of impactful work that addresses key societal challenges

(REF5a 2.2). Psychology staff contribute to two of the MDRTs: ***Integrated Health & Social Care*** **and** ***Human and Digital Design***.

Future strategic aims have been articulated by the Psychology Research Committee, chaired by the Psychology Research Director (**Coventry**), and with members: PGR Director (**Haskell-Ramsey**), REF UoA lead (**Briggs**), Head of Department (**Moss**) and research group leads (**Myachykov, Saxton, Wetherell).** These aims prioritise innovative, internationally recognised research that has societal impact. Specific targets include: (i) raising the proportion of staff with significant responsibility for research to 100% of staff in scope (ii) the strategic recruitment of new talent, utilising the opportunities for Vice Chancellor's Research Fellow (VCF) appointments that transition to senior lectureships, (iii) providing improved infrastructure support for the highly distinctive specialist research centres/laboratories and promoting multidisciplinary work in sleep, nutrition and digital interaction, (iv) growing exciting new work at the intersection of social and evolutionary psychology, promoting interdisciplinary collaboration through our multi-disciplinary research themes, (v) developing better working relationships with relevant non-academic partners in order to maximise the impact of our research, (vi) enhancing sabbatical opportunities for the growing numbers of academic staff, (vii) strengthening our PGR community, including applications for doctoral training partnerships, and (vii) improving open science practices across the discipline.

Our research groups and their relationship to these aims are described below.

1. The Cognition and Neuroscience Group

This group, led by **Myachykov**, was formerly 'Cognition and Communication' and has grown from 10 to 18 staff, with new research expertise in reading development (**Blythe, Pagan Camacho**), applied cognitive neuroscience (**Craig, Watermeyer**) cognitive distortions (**K Cornelissen, Moseley**, **Tovee**) and expert performance (**Bilalić).** The group combines behavioural and neuroscience approaches to cognitive development, attention and perception, memory, decision making, linguistic communication, including sentence comprehension, discourse, dialogue and reading, embodied and situated approaches to cognition and communication, neurodevelopmental disorders, and the neurocognitive basis of sleep. A distinctive feature of this group is the application of novel research methods including fMRI, EEG, MEG, TMS, and 3D body modelling. An example project is **MapMe** (**Tovee,** working with colleagues at Newcastle University), which addressed child obesity by targeting parents' under-estimation of their child's body size. An intervention was developed that led to a significant reduction in children's BMI, and this has since attracted funding of £1.5m for a full-scale randomised control trial (RCT) with 8,000 families recruited across 12 Local Authorities (NIHR project 127745, March 2020-Feb2023, **Tovee** as CoI).

The following research themes (with associated staff) are found within this group:

- ***Language and Communication*** **(Blythe, Camacho, Haigh, Myachykov, Taylor).** Here, the focus is on human communication and discourse, psycholinguistic theory, language development and learning, reading, and embodied approaches to language and cognition.
- ***Memory, Perception, and Attention*** **(Constable, Hamilton, Heffernan, McInnes, Orme, Rajsic, Riby).** This encompasses research into the cognitive and neurophysiological aspects of attention, perception, and memory including understanding impact of ageing on cognitive performance, effects of alcohol and smoking on memory performance, the contribution of individual differences, autism, and other factors to working memory, cognitive and neurophysiological mechanisms of attentional control and the organization of working memory.
- ***Neuroscience and Neuropsychology*** **(Bilalić, P Cornelissen, , K Cornelissen, Greer, Moseley, Riby, Tovee).** This includes the investigation of psychophysical and neurophysiological properties of human physical attractiveness and body image, neural underpinnings of reading and visual word recognition, neural basis of semantic cognition and the neurological basis of ASD, autism, and eating disorders. Staff use multimodal imaging/neuroscience methods to investigate topics across the lifespan such as self-generated thought, mind-wandering, creativity and how this is associated with wellbeing.

2. The Health and Wellbeing Group

This group, led by **Wetherell**, was formerly the 'Health in Action' research group, but it has grown significantly, with over 30 academics involved in its research (compared to eight in REF2014). It includes the work of chartered Health, Clinical and Occupational Psychologists as well as research experts in psychobiology, behaviour change, developmental disabilities, psychopathology and nutrition. The group has benefitted from the establishment of the *Integrated Health & Social Care MDRT* (REF5a 2.2) and by the arrival of eight new staff with expertise in psychopathologies (**Barkus, K Cornelissen, Craig, Dodd, Kraueter, Moseley, Smailes, Watermeyer**). Examples of the group's translational work in mental health include **Deary's** work on improving our understanding of patients with persistent physical symptoms and the associated development of new clinician training packages and associated patient resources, and **Dodd's** work on student mental health, through her contribution to the UK's Student Mental Health Research Network (SMARtEN) and the Office for Students project (BRinging Innovation to Graduate Mental Health TogethER (BRIGHTER).

The following research themes (and associated staff) are aligned to this group:

- ***Psychobiology of Stress and Wellbeing*** **(Wetherell, Hope [formerly Mitchell], Haskell-Ramsay, Lovell, McGann, Smith, Rippon, McInnes, Pepper).** Novel methodologies are used to assess psychological (e.g., personality, mood, coping),

behavioural (e.g. recreational drug use, smoking, alcohol and diet) and biological (e.g., nervous, endocrine and immune system function) processes using state-of-the-art laboratories and real-world assessment techniques. The research supports the development of bespoke interventions and assesses their feasibility for healthy, clinical and occupational populations.

- ***Health Behaviour and Behaviour Change*** **(Deary, Heffernan, Newham, O'Brien, Saxton, Shepherd, Wolfson).** Here, mixed methods are used to assess behaviour and develop, implement and evaluate behaviour change interventions. This research draws upon expertise in systematic reviewing, meta-analysis, intervention co-design, and conducting randomised and pragmatic trials across a range of populations. This work also contributes to the behaviour change programme of Fuse: the Centre for Translational Research in Public Health (http://www.fuse.ac.uk/).
- ***Hoarding Research*** **(Briggs, Hamilton, McInnes, McKellar, Neave, Sillence, Saxton Smailes).** A recent multidisciplinary research initiative that aims to foster a better understanding of Hoarding Disorder and explore the impact of this disorder on the individual and society. The research involves close collaboration with external agencies including Housing Associations, Local Authorities, Emergency Services, GCHQ, the NHS and charities.
- ***Research and Practice in Developmental Disabilities (*****Greer, McKenzie, Riby),** involving a multidisciplinary and systemic approach to research and consultancy and the development of clinical applications relevant to children and adults with developmental disabilities, including those with an intellectual disability, and Autism Spectrum Disorder.
- ***Psychopathologies*** **(Barkus, K Cornelissen, Craig, Dodd, Kraueter, Moseley, Smailes, Watermeyer),** encompassing research on neurodegenerative diseases, psychosis, and bipolar disorder, as well as research documenting the experiences associated with these problems (e.g., hallucinations, mania). Researchers use a range of qualitative and quantitative methodologies to assess the biological, social, and psychological processes involved in the development of psychopathology, as well as developing interventions that aim to improve the health and well-being of people affected by psychopathology.

3. The Evolution and Social Interaction Group

This group is an expansion of our former 'Evolution, Perception and Behaviour Group' where we returned six staff in 2014 compared to 13 here. Led by **Saxton**, the group uses social and evolutionary theory to understand perception, attitudes and behaviour within both offline and online social settings. A targeted recruitment strategy has expanded the original evolutionary psychology group to also include new staff with a strong social psychology profile (e.g. **Brown, Linden, Paterson, Pollet, McNeill and Shepherd**). This has allowed distinctive work to take

place at the interface between evolutionary and social psychology and technology. The group has invested in highly sophisticated motion capture equipment (see infrastructure, below) and has been successful in attracting funding from diverse sources (including Leverhulme Fellowships to **Saxton** in 2014 and 2020 and Facebook funding to **Pollet** in 2019). The major research themes associated with this research group are:

- ***Perception, Evolution and Behaviour*** **(Bovet, Honekopp, McCarty, Neave, Newman, Saxton, Pollet)** where current research includes investigations into inequalities in health and ageing, interpersonal relationships, mating behaviours and preferences, and movement. Researchers take a multidisciplinary approach to ask not only how, but why humans perceive and behave the way they do, drawing ideas and expertise from cognitive neuroscience, cognitive psychology, physiology, evolutionary biology, and animal behaviour.
- ***Social Psychology*** (**Hope, Jolley, Linden, Paterson, Shepherd, Thompson**) addressing intrapersonal, interpersonal and intergroup processes, this research explores processes of gender identification, the personal characteristics associated with, and the psychological consequences of conspiracy theories, the emotional and behavioural consequences of hate crime and sexual objectification, and the factors that contribute to the development of intergroup discrimination and conflict.

As noted above, three dedicated research laboratories/centres also conduct more tightly focussed, but highly distinctive psychology research:

1. The Northumbria Centre for Sleep Research (Elder, Ellis, Santhi)

This research laboratory, including a purpose-built two-bedroom en-suite facility (section 3), has links to both the Cognition and Neuroscience and Health and Wellbeing Groups and is a collaboration of experts with diverse backgrounds including experimental and applied psychology, neurophysiology and neuropsychiatry, chronobiology and medicine. Research programmes broadly encompass social cognition and sleep, paediatric sleep and learning, dreaming and states of consciousness, sleep, the ageing brain and neurodegeneration, and the psychophysiological and neuropsychological correlates underpinning the pharmacological and non-pharmacological management of poor sleep. This group has attracted PHE funding for translational sleep research, has recently developed highly innovative Cognitive Behavioural Therapy Interventions for Insomnia (see ICS) and has contributed to European Guidelines for the Treatment and Diagnosis of Insomnia.

2. The Brain Performance and Nutrition Research Centre (Dodd, Jackson, Haskell-Ramsay, Kennedy, Moss, Wightman, Watermeyer)

BPNRC conducts highly original and impactful research on nutritional interventions (https://www.nutrition-neuroscience.com/). The laboratory runs a wide-ranging portfolio of randomised controlled trials investigating the cognitive mechanisms and mood effects of herbal extracts, nutraceuticals and food supplements. This research uses novel methodologies, including bespoke cognitive assessments (e.g. Cognimapp, COMPASS) and unique study paradigms (e.g. NIRS, indirect calorimetry) to explore the effects of dietary interventions on the interaction with human biology and how changes in blood chemistry, metabolic factors or the microbiome, are associated with changes in brain function and psychological well-being. BPNRC has received in excess of £2.3m industry funding during the current REF cycle for clinical trials and collaborative PhD studentships to explore a range of novel nutritional compounds including iron and vitamin C (Bayer Consumer Care); resveratrol (Evolva); and omega-3 fatty acids (BASF). Research generated from collaborative studies with industry leads to high quality publications and is used to inform product development and marketing strategy, activities that are often associated with financial benefits for the industry partners involved (see ICS).

3. The Psychology and Communication Technologies Lab (PaCTLab) (Briggs, Brown, Coventry, McNeill, McKellar, Sillence, Thomas)

PaCTLab seeks to understand the psychology of human interactions through digital technologies including the digital dissemination of (mis)information (https://pactlab.co.uk/). This laboratory is linked to Northumbria's *Human & Digital Design* MDRT and contributes to the University's widely acknowledged global status as a centre for multidisciplinary work in Human Computer Interaction. PaCTLab is distinctive in the UK for conducting human-computer interaction work that draws heavily on psychological theory and models. The lab has attracted over £2m in research awards during the REF period, with research projects addressing issues of privacy, security and trust and the impact of technology (including social media) on identity and behaviour. An additional strength of PaCTLab is the focus on inclusive and participatory, value-sensitive design and the commitment to exploring issues of social injustice that can arise from various forms of digital communication. PaCTLab researchers forge links with industry and policy-makers through their (founding) membership of the UK's Research Institute in Sociotechnical Cyber Security (RISCS) and their membership of the network of Academic Centres of Excellence in Cybersecurity Research (ACE-CSR). An ICS gives details.

Taken together these three groups and three specialist centres/laboratories have delivered a more than three-fold growth in research activity for the Unit since REF 2014 and have built a strong international presence, evidenced by 314 outputs in the REF period with international co-authors and citations from 127 different countries. The groups contribute towards regional, national and

international priorities around *inter-alia* Digital and Health and Life Sciences, the Ageing Society, AI and Data (see REF5a Figure 1).

Open Science and Ethics

An important development, since 2014, has been the promotion and increasing adoption of Open Science Practices. Researchers are kept fully briefed on Open Access and Data Management policies via University Library team presentations. Funding for OA publishing payments are made available when outputs meet relevant quality criteria. Psychology joined the UK Reproducibility Network, with the view of further promoting open science and reproducible scientific practices among its staff and students. Workshops are held on the open science framework and postgraduate research students are now required to preregister their research projects. All are encouraged to engage in data sharing via third party sites as well as peer-to-peer scrutiny in accordance with **FAIR** guidelines that research data should be **f**indable, **a**ccessible, **i**nteroperable and **r**eusable. Finally, staff have been involved in large scale, crowdsourced projects focussed on replicating core findings in Psychology (e.g. 'Many Labs 2'), as described in section 4.

All researchers are committed to maintaining the highest standards of academic and ethical integrity. All staff follow the British Psychological Society Code of Conduct and research is subject to full independent ethical review, overseen by the Faculty Ethics Committee and Director of Ethics. Moreover, our research is monitored for full compliance with appropriate external ethical standards (e.g. NHS), supported by an internal approval process for submissions to the Integrated Research Application System. Staff who are leading clinical trials and health interventions are encouraged to publish protocols and register their work with ClinicalTrials.gov or the ISRCTN registry. All staff have access to extensive online resources to support effective Ethics & Governance processes and undergo annual mandatory training on GDPR, 'Research Ethics' and 'Information Security and Awareness', as well as Health & Safety training.

2. People

Staffing Strategy and Staff Development

Our strategy for building international excellence involved a significant recruitment drive, but we also provided more effective research support for all academic staff, PGR and contract researchers. This aligns to the University's strategy for building upon the success of REF 2014 by improving research 'power with quality' (REF5a 2.1). The 62 staff FTE (94%) returned in this submission include 7 staff that were in post, but not included at REF2014 and all those who were submitted in REF2014 and remain at Northumbria (including six who were submitted to other UoAs). Of these, 14 have been promoted since 2014. Only four staff did not meet the criterion of '*significant responsibility for research'*, as defined in Northumbria's approved Code of Practice.

The research groups aim to (i) provide an environment of inclusivity (with all staff engaged in research), (ii) offer mentorship, peer support and joint learning for the group members and (iii) ensure a critical mass of researchers and PGR across all levels, to create a stimulating and vibrant community. These groups provide the focus for the development of new theory and methods within the discipline. Innovation and good practices are communicated to all via weekly or fortnightly seminars within groups, Unit level seminars, workshops and multi-disciplinary seminars. The latter are often tied to the University's MDRTs. For example, a weekly Wednesday lunchtime seminar that unites the *Human & Digital Design* researchers took place physically prior to the COVID-19 pandemic but was rolled out virtually during the pandemic, and made available to an external audience, with up to 85 attendees, several from overseas research institutions.

New Appointments

We adopt stringent criteria for the recruitment of new academics, involving diverse members of the Psychology Department in the recruitment process. In addition to a formal interview panel (where HR policy ensures an appropriate gender balance), applicants make presentations to various audiences, including a research panel, to ensure that successful applicants would be able to make a meaningful contribution across all facets of academic activity. All panel members receive EDI training (for example, training in unconscious bias). Candidates are offered the option for selection events to be online (e.g. via Teams). This supports international applicants as well as those with caring responsibilities. In the current submission, 15 (24%) of the submitted staff are international (including 7 EU) as opposed to 4 (21% - including 1 EU) in 2013/14. Successful applicants are offered the opportunity for a funded visit to meet more informally with existing staff and to see our research facilities. The number of applicants for such positions has increased significantly during the REF period. For example, in 2015/16, we received 56 applications (28 female) for academic appointments, with five appointments made (2 female). In 2018/19, we received 351 applications (230 female) with 20 appointments made (13 female). In terms of level of first appointment, most new appointments made during the REF period were at lecturer/senior lecturer level, as shown in Table 1, although five appointments (making up 8% of of submitted staff) were made to the Vice Chancellor's Research Fellow scheme (VCF), a university initiative to attract high quality research-led appointments, prior to embedding these as permanent academics (REF 5a, 2.2, 3.2).

VC Research Fellow		Lecturer/Senior Lecturer		Associate Professor		Professor	
Female	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**
3	2	17	10		1	1	2

Table 1: New appointments since 2014, split by gender

For new academic staff, mechanisms are put in place to help them establish an independent research career. They are given reduced teaching loads in their first year and have research mentors assigned to them, who help them develop applications for competitive external funding (e.g. new investigator awards), target appropriate hiqh-quality journals, adopt open science practices and access the research resources available across the university. There is a policy of prioritising new staff, working in collaboration with more established researchers, when allocating internally funded PhD studentships and when applying for capital equipment. We are sensitive to EDI issues from the outset and new appointees are encouraged to discuss any specific working needs with the Head of Department. Part-time arrangements as well as other forms of flexible working have been offered and taken up in recent years. Considerable efforts have also been made to guide EU staff throughout the Brexit process, including refunding of application fees for EU colleagues seeking permanent residence in the UK or British Citizenship. Northumbria also reimburses immigration costs for international colleagues (REF5a 3.3) and operates an Immigration Fees Short-Term Loan Scheme for those needing additional assistance with other immigration costs.

Career Progression, Promotion and Support

We support career progression and promotion for academic staff and there is an annual call for applications for promotion to Grade 8 (Associate Professor) and 9 (Professor). All academic staff are eligible to apply, with no limit on the number of promotions available. Of the 11 professors (4 female) currently in post, seven (3 female) achieved their grade through internal promotion, and 15 researchers (7 female) gained promotion to Associate Professor or Professor during this REF period. Overall, the proportion of staff in senior research leadership positions (Associate Professor or Professor) is 27% - similar to the proportion returned in 2014. Currently 91% of in-scope academic staff have doctorates (as opposed to 84% in 2013/14) and those without are chartered psychologists with professional qualifications. These are offered opportunities for professional doctorates or doctorates by publication and two of our Chartered Occupational Psychologists have recently completed the former route. All staff are made aware of the University's Academic Promotions Policy and the criteria for promotion and progression are clearly set out on the university intranet.

All staff members have an annual Performance and Development Appraisal meeting, normally with the Head/Deputy Head of Department (HoD) or Research Director. In these, resource and training requirements are identified, workloads set and milestones agreed for the attainment of specific research and career goals (e.g. external grant funding, impact, publications, goals for academic promotion). Where possible, for academic staff, the balance of research, teaching and administration roles are targeted at 40%:40%:20% respectively, but individual staff circumstances

are taken into account, with the most recent data for submitted staff showing a research/teaching/administration balance of 49:36:15%.

The research development and promotions trajectory for all staff is considered carefully at Northumbria. Contract researchers – typically post-doctoral research associates - are fully integrated into the Unit, are invited to regular departmental meetings and encouraged to contribute to seminars and to discussions around strategy and research planning. Where possible, they are encouraged to apply for funding or are included as named researchers on funding applications to ensure continuity. There are role models for contract staff wishing to apply to academic appointments, as our Head of Department (**Moss**) and Director of the BPNRC (**Kennedy**) made the same transition.

Semester-long sabbaticals are open to all academic staff and are allocated on an annual basis in order to deliver significant contributions, such as books (e.g. Research Methods in Developmental Psychology, Routledge; **Riby**) or large scale international research initiatives e.g. the Reach study (*Researching Eating Activity and Cognitive Health*), a collaboration with Massey University, Auckland (**Haskell-Ramsey**). Typically 3 or 4 staff have taken sabbaticals each year, often basing themselves in other institutions (e.g. University of British Columbia, University of Sydney, University of California, San Diego), in order to forge closer collaborations or to learn new research techniques. Given the large growth in staff numbers in recent years, a strategic priority is to grow opportunities for more staff to take research sabbaticals each year. QR funding is used to supports the travel and subsistence of those taking up sabbaticals overseas and to support the strategic release of staff from teaching duties. Other QR funding is available to support shorter term external visits (or visiting faculty) and a travel budget supports staff (with priority given to ECRs) giving oral presentations at National and International conferences.

The university has mechanisms in place to support and incentivise applications for funding. An online repository of successful grant applications is available and a training programme is offered to support ECRs develop their capacity to apply for large awards. Local support is available for ECRs applying for smaller awards and there has been considerable success in diversifying sources of funding, with examples including new awards for ECRs from the National Eye Research Centre, WhatsApp, the North East Leadership Academy, UKRI, and the Royal Society. In addition, the university regularly offers pump-priming awards. For example, in 2019 an internal funding opportunity was set up to enable academic investigators to undertake activities that would develop/strengthen engagement with an industrial partner and position the investigator for a successful significant funding application to the Industrial Strategy Challenge Fund.

The University's Research and Enterprise Rewards Scheme provides those staff who have successfully secured research grant and contract income with additional financial rewards of up to £5K p.a. to spend on developing their research. A QR research budget (typically £25K per annum) provides funds for consumables, small pieces of kit and software, and participant payments to support research. Small grants are available for networking, speaking at conferences and workshops, pump-priming pilot studies and to support consumables for research projects. Priority is given to ECRs and new staff who have limited access to external resources, but internal funding can also be used to bridge research activities following periods of disruption (e.g. due to ill health). Further funds can be accessed through the MDRT (*Integrated Health & Social Care*; *Human & Digital Design*) and through centralised university impact funding. The university also supports research by awarding paid UG and PG research internships, which are aligned with internal research groups and their themes. Students can also undertake their research placement modules within these research groups. We support both undergraduate and masters students to apply for external internship funding and notable successes include summer funding from the British Psychological Society, the Experimental Psychology Society, and the Alzheimer's Society.

Research Students

PGR students are a central part of our research culture and the University provides a **Research Development Fund** (REF5a 2.2) offering fully funded studentships (**around 6 p.a. in UoA4**, typically advertised in areas that will support research priorities and that also align with newly appointed/ECR staff). Additional 'matched' University funding is made available to support **Collaborative PGR** studentships with external partners (REF5a 3.5), whereby the university will match the external amount provided, with examples including PGR funding from Evolva and BASF (Norway). Applications are also supported through the Northern Bridge Doctoral Training Partnership. High calibre candidates are recruited though supervisors' networks and advertisement, notably on *FindAPhD*. All PGR recruitment follows fair and effective recruitment practices implemented by the Graduate School.

All students have a Principal Supervisor and at least one other academic supervisor who meet regularly with their students (monthly documented meetings as a minimum, as well as more frequent informal meetings) to provide research direction, support and guidance. In this we follow The Graduate School Code of Practice, which is reviewed and updated annually. All students complete an initial project approval template together with a PGR Development Portfolio (Vitae) template within three months of registering. Arrangements for distance working are made where appropriate. Subsequent annual reviews allow for PGR progress and training needs to be formally reviewed. The 'subject specialist' on the candidate's annual progression panel will typically be the same individual throughout the programme, which provides another mechanism via which continuous academic support is available to the candidate throughout their PGR studies.

The Graduate School provides a structured training programme with sessions on statistical analysis, bibliographic software, academic writing skills and ethics in research. Themed workshops are offered on 'doctorate essentials', 'managing your research degree', 'giving your research impact', and 'life after your doctorate'. Taught research training modules within our MRes programme are also available to PGR, such as training in quantitative and qualitative methods, academic skills training (including sessions on dissemination of research, and grant application writing), training in specialist equipment (e.g. polysomnography), statistical analysis using R software and engagement with open science practices.

As a consequence of a strong and supportive framework for PGR supervision and training, the Unit performs well in the Postgraduate Research Experience Survey (**85%** overall PGR satisfaction in 2019 versus a sector average of 82% for this discipline area). Particular attention has been paid to the needs of PGR students during lockdown, where alternative data collection approaches have been shared across the PGR community in order to continue work with human participants that would otherwise be disrupted by COVID-19.

PGR students are required to attend departmental research seminars and give presentations within their particular research groups. They are also encouraged to present at international and national conferences (with travel funds awarded on a competitive basis). Students in Cognition and Neuroscience have benefited from the activities in the *Human & Digital Design* MDRT and students in the Health and Wellbeing group have been involved in initiatives across the university and associated with the *Integrated Health & Social Care* MDRT. They benefit from non-academic collaborations and become involved in academic/industry/policy workshops and events. Examples include student involvement in a UK Government policy-oriented event in 2020, organised in collaboration with the National Cyber Security Centre and a regional CyberFest organised by Dynamo in 2019. Students are also encouraged to present at the annual University and/or Faculty Research Conference. Unit staff hold roles on conference committees (section 4) and we encourage students to become involved as volunteers and reviewers and to get involved in organising international symposia. Success with these initiatives is evidenced by students who win national prizes, including those presented by the BPS Psychology Postgraduate Affairs Group and BPS PG thesis award.

Equality and Diversity

The University is committed to promoting and supporting equality of opportunity and diversity both as a focus for research and as good practice for our own workplace. In research terms, an emerging group of applied work psychologists (e.g. **Longstaff**, **Thompson**) are currently working on research projects with police forces in England on the career progression of women in policing,

and with the NHS on bullying and bystander behaviour. The strategic aim here is to add to Northumbria work that informs policy and practice around workforce development, inequalities and social injustice. This group supported the department's successful 2020 application for a Bronze Athena Swan Award, with the assessors commending the "*evidence and narrative around the culture of the department*" and highlighting the presence of "*a strong and structured approach to making improvements*". They liaise with a *Workforce & Practice Development* group within *Applied Sciences* (UoA3) that addresses these issues in the healthcare professions. Social injustice is also a theme of the Centre for Digital Citizens, where the influences of algorithmic social bias are considered in relation to race, gender and disability.

The gender balance of both eligible and submitted staff is equal (51% female and 49% male) and the age profile of eligible and submitted staff is similarly matched. For example, there are 13 staff aged over 55 and all are submitted. More could be done to encourage diversity in terms of disability - where 2% of eligible and submitted staff have a registered disability, and ethnicity - where 2% of eligible and submitted staff are BAME, but steps are being taken to address this. In 2020 the University signed up to the Race Equality Charter to further its commitment to combat racial inequality, and has recently established a member-driven Black, Asian and Minority Ethnic Staff Network and the University is a Level 2 member of the Disability Confident Scheme which means that staff with underlying conditions or declared disability are supported by reasonable adjustments to their workload/workspace where needed. As noted earlier, all staff attend Equality and Diversity training, with appropriate additional training mandated for those taking part in selection panels, conducting appraisals, and taking up line management roles.

The University's Code of Practice used in preparing this submission was developed with an underpinning commitment to fairness and EDI. The UoA lead (**Briggs**) and relevant staff have been given unconscious bias training provided by Advance HE. The UoA lead co-ordinated the internal peer review of outputs by 'colleges' of suitably experienced psychology staff, the composition of each reflecting the need to maintain a gender balance appropriate to each area and to consider succession planning i.e., staff gaining experience for future REF preparations. The output portfolio was selected by first attributing a primary output to each individual (typically their strongest output, although with management of co-authored outputs to maximise the expected Grade Point Average), followed by 'blinded' selection of the highest scored outputs needed to make up the total. Where the option was available to select from equally graded outputs, equality assessments and the need to consider fair representation of all the discipline areas in this wide-ranging submission were taken into consideration.

3. Income, infrastructure and facilities

External Research Funding

Psychology received £4.76M in external funding during this REF period, with RGCI increasing steadily from £780K in 2013/14 to almost £1.1m in 2019/20 (Table 2). The new *Centre for Digital Citizens* (EP/T022582/1; **Briggs/Coventry**) was launched in October 2020, which means the £1.7M income to Northumbria is not realised in the current REF period, but signposts a successful strategy for more large-scale, interdisciplinary applications.

	13/14	14/15	15/16	16/17	17/18	18/19	19/20	Total
Awarded	780,059	691,058	817,354	952,975	616,184	815,085	1,058,948	5,731,663
Number	29	43	44	36	34	48	72	306
Value	£2.8m	£4.6m	£4.8m	£3.9m	£10.2m*	£3.1m	£14.4m*	£43.8m

Table 2: RGCI income (row 1) applications (row 2) and value (row 3) over the REF period
*includes two ESRC Centre applications

Research applications have also risen over the REF period, with 29 applications made in 2013/14 as compared to 72 in 2019/20 (Table 2) and are projected to increase further as the significant number of recently appointed staff establish themselves. The overall picture in the last 12 months is that 48% of the department's successful applications were led by female PIs. The larger awards (for example, H2020 and EPSRC awards) were led by female PIs, who provide mentoring for new female members of staff, offer timetabled sessions on attracting larger awards to ECRs across the university and are available to offer research grant advice on request.

Funding comes from diverse sources, including the EU, UKRI (with EPSRC our largest funder), the NHS (including NIHR, local Trusts and the AHSN North East and Cumbria), government (including GCHQ), industry (e.g. Pepsico, Philips, Facebook) and charities (e.g. the Leverhulme Trust, the Alzheimers' Society). Funding is distributed across the six psychology research groups, although the three specialist centres, whilst relatively small in staff terms, attract significant awards. The PaCTLab is highly distinctive in applying psychological models of attitude and behaviour change to digital interactions which means it is well positioned to be a psychological partner in large-scale European and UK multidisciplinary studies. These include four H2020 projects awarded to **Coventry** and/or **Briggs**: The DALI project (2011-2014. Euro3.2m) which explored digital interventions to improve the mobility of Older Adults, the ACANTO project (2015-2018, £4.3m) a follow-on project that looked at digital social nudges to improve mobility, the CYBECO project (2017-19, Euro1.98m), which addressed behavioural issues influencing the uptake of cyberinsurance, and the PANACEA project (2019-2022, Euro4.96m) with a focus on data protection and privacy issues within healthcare.

Members of PaCTLab have also been successful in attracting EPSRC funding, notable amongst the projects being the £1.2m *Reel Lives* project (EP/L004062/1) on the management of digital identity, led by Northumbria and with partners Edinburgh, Open and Birmingham Universities; the £1.1m EPSRC *Cybersecurity across the LifeSpan* (cSALSA) project with £290K for Northumbria and with partners Bath (lead), Portsmouth and Cranfield Universities; and the £828K EPSRC INTUIT project. Finally, as noted above, **Briggs** and **Coventry** are Co-Investigators on a successful new ESRC Digital Economy application to set up the new *Centre for Digital Citizens* (£1.6m to Northumbria). Taken together, this tranche of European/UKRI funding illustrates the strength of the PaCTLab in building strong international and interdisciplinary collaborations, where Northumbria staff contribute expertise in psychological theory and methods. In all cases where projects have been completed, they have been well rated by external assessors, with the Northumbria contribution having been labelled as 'exemplary' for the H2020 ACANTO project. An ICS relates to this group's cybersecurity work.

The BPNRC has an international reputation for research assessing the effects of nutrition and dietary interventions on brain function and is almost entirely externally funded, mostly by collaborations with industry. BPNRC has worked with many global food and nutraceutical leaders including BASF, Bayer, Danisco, Frutarom and PepsiCo, along with UK companies such as Pukka Herbs and Vitabiotics. This collaborative research provides an important evidence base for product efficacy and product claims, the impact of which is presented in a case study developed from these trials. Other examples include work with Bayer Consumer Care (total value of 3 studies £233K; **Kennedy** and **Haskell-Ramsay** as PI) to evaluate the subjective fatigue effects and underpinning mechanisms of new formulations of one of their global multivitamin/mineral brands, a collaboration with Frutarom (total value of 4 studies £371K **Kennedy**) to establish efficacy and dosing of a novel herbal supplement and work with PepsiCo (total value of 4 studies £199K, **Kennedy**) to evaluate different formulations and dosing of functional drinks containing polyphenols and herbal extracts on cognition, mood and cerebral blood flow.

Longer term collaborations also provide the opportunity to explore the effects of specific components of the diet across a wide range of parameters as well as their underpinning mechanisms. For example, work with BASF (£320K, **Jackson**) investigated the effects of a novel omega-3 fatty acid supplement with enhanced bioavailability on cognition, mood, sleep quality, and cerebral blood flow; a collaboration with Evolva (**Kennedy** Co-I) explored the effects of the polyphenol resveratrol on cognitive function, mood and inflammation in overweight and obese individuals, enabling the interrogation of links between specific metabolic responses and gut microbiota colonisation to changes in cognition. Recently, the capacity of BPNRC for multi-disciplinary research (in collaboration with staff returned in UoA3) has attracted a number of grants and contracts from industry partners (e.g. Bayer consumer care £85K, **Jackson**; Pukka Herbs

£101K, **Wightman**) and research councils (e.g. the International Nut and Dried Fruit Council £100K, **Haskell-Ramsay**) interested in investigating the effects of supplements, nutrients or whole foods on the gut-microbiome-brain axis. The creation of NUTRAN as an externally facing, multidisciplinary clinical trials unit is a strategic step to grow these kinds of partnerships.

The Northumbria Centre for Sleep Research receives funding from a variety of sources, largely from organisations related to health and healthcare. Research examining the pathophysiology of insomnia has been funded through two large awards (ESRC £431K and NIH $570K to **Ellis**, with colleagues from the University of Pennsylvania) and several related awards (e.g. Royal Society of Edinburgh, Wellcome Trust). From this work a successful training package on the assessment and early management of sleep health and sleep disorders has been commissioned, including aligned research and audits, by several NHS partners, UCB Pharma, The Royal College of Surgeons in Ireland and the Sleep Council (totalling £128K). Significant funding has also been attracted for research focused on understanding the relationship between stress, sleep and fatigue, including from charities (Action 4 ME, Macmillan, and ME Association), government agencies (Health Education England North East, Public Health England, Transport for London) and industry (Calms, Cherry Active, Mayborn, Phillips). An emerging area of expertise within the group is chrononutrition and this programme of work has already received funding in relation to food timing and sleep-related glucose regulation from Nestle, Unilever and Pukka and on supplementation timing on human performance and recovery from Irish Rugby Football Union and Sport Ireland (totalling £141K). Most recently, the group has been commissioned by Public Health England to conduct a series of rapid reviews on sleep and health for the Secretary of State (£112K).

The three wider research groups also attract significant research grants from diverse sources. For example, **Dodd** has had considerable success for her work on student mental health, with a recent award of £413K from the Office for Students (BRinging Innovation to Graduate Mental Health TogethER (BRIGHTER) and £263K from NIHR Research for Patient Benefit: The clinical and cost effectiveness of adapted Dialectical Behaviour Therapy (DBT) for Bipolar Mood Instability in primary care (ThrIVe-B programme). The student wellbeing work provides another example of large-scale UK-wide collaboration, with £911K UKRI funds awarded to the Student Mental Health Research Network (SMARtEN), where **Dodd** is Co-I. Other awards include a Leverhulme grant of £68K to **Haigh** to explore public understanding of science and a Leverhulme fellowship (£54K) to **Saxton** to explore the effects of natural infant odours on parents. **Myachykov** and **Taylor** have recently secured an Erasmus+ Capacity Building grant (£43K) to work in collaboration with seven other universities from France, Denmark, Russia, and India. The resulting I-Brain consortium's main goal is to develop a new Master's-Doctoral track with the focus on cognitive, neuroimaging, and modelling applications (http://ibrainproject.eu/).

A wide variety of funders support a body of work on disability and chronic healthcare, often with a focus on healthcare inequalities. For example, **O'Brien** has an award from NIHR's Public Health Research Programme (£502K) to assess the impact of a community social prescribing on people with type 2 diabetes living in an ethnically diverse area of high socio-economic deprivation and a NIHR Applied Research Collaboration (ARC) North East and North Cumbria award of £33K to improve the accessibility of medicines review services in primary care for older people from BAME communities.

McKenzie's work on supporting carers for those with longer-term conditions and improving strategic workforce development has been funded, firstly by Health Education England, (£101K) and by the North East and North Cumbria NIHR ARC (totalling £368K). A series of awards to **McKenzie** and **McCarty**, including a total of £45K for two NHS Lothian pilot studies and £38K from the NIHR ARC has improved screening for intellectual disability in a homeless population begun to address their health inequalities, and £107K from the Edinburgh and Lothian Health foundation has involved improve screening for intellectual disability in a paediatric population

Finally, relatively new funding bodies include Facebook UK, with a Facebook research award to **Pollet**, to examine how Instagram use is related to offline social networks and well-being (£32K), and GCHQ, who recently funded **Neave**'s work on Digital Hoarding (£49K).

Internal Support

The Unit operates several mechanisms to help build research income. New staff are allocated research mentors to advise them on internally available support and peer review processes available to improve the quality of applications. In-kind support is often offered informally through the research groups and laboratories, with more senior colleagues raising awareness of new funding opportunities, supporting established staff and ECRs to develop independence in application writing and providing the opportunity for peer-review. Where cross-disciplinary applications are appropriate, the MDRTs exist to help forge new synergies between disciplines and the more established researchers work to involve ECRs in large collaborative applications.

Centralised support comes from our Research and Innovation Services team in terms of pre- and post-award co-ordination and research management. Psychology staff have a dedicated research manager who advises on costing applications and a faculty impact advisor ensures opportunities for developing high quality impact are highlighted. Staff are also able to access a separate Sales and Business Development team who help with KTPs and InnovateUK funding, as well as supporting researchers in finding appropriate industrial/non-academic partners.

In addition to the QR budget used to support staff development (see above), some elements of external funding are also available to support internal development more widely. Thus, **Briggs** and **Coventry** lead the University's multi-disciplinary Academic Centre of Excellence in Cybersecurity Research, which receives an award from EPSRC/NCSC of £60K to organise events and other development activities across the University, including support for PGR wishing to attend cybersecurity events within the wider Cybersecurity Research network.

Capital Spend and Infrastructure

The UoA has the research facilities expected of a large Psychology Department but also houses specialist equipment for sleep polysomnography, virtual-reality, body-scanning and motion-capture, that help make Northumbria's research offer distinctive. Investment of £431K during the current REF period has led to the redesign of facilities to grow the dedicated research space. An example of infrastructure investment during this time was the addition of a clinical testing facility to the BPNRC. In addition, the university has made significant investments in dedicated research equipment, sourced from an annual capital expenditure programme that allows staff to request for dedicated research equipment costing over £10K.

Significant new investments include: a recently furnished virtual reality (VR) suite that includes both Oculus, and HTC Vive Pro VR headsets, the latter have been upgraded with a fully wireless interface linking to a powerful computer with cutting edge hardware-accelerated graphics specifically for the stresses of VR. This VR suite services researchers in the areas of clinical and social psychology. Projects include: investigating the psychological effects of walking around low-SES neighbourhoods (**Pepper**), and the cognitive distortions exhibited by eating disordered patients in judging body size (**P/K Cornelissen**). For body image work, the VR suite is used alongside two full-body volumetric and photogrammetric body scanners. The SizeStream scanner allows for accurate volumetric scanning and measurement of bodies, whilst the 3DMD photogrammetric 10-camera 3D body scanner allows researchers to capture both volumetric and photographic detail of participants. These facilities enable our researchers to allow participants to experience themselves in VR at varying level of adiposity, thus addressing one of the criticisms of the current literature regarding the lack of a 'self' component in body size judgements.

A large Vicon motion-capture and biomechanics laboratory (established in collaboration with UoA24 colleagues) allows for full body motion capture, accurate hand tracking, and full-face capture. The laboratory houses 14 high-speed near-infrared motion tracking cameras, providing a unique flexible tool for empirically investigating perceptions of biological motion and likely one of the largest and well-equipped such facilities in the country For example, it is used to record intricate gestures that have been used by clinical psychology researchers to investigate emotion recognition from dynamic stimuli with those with Autism, whilst colleagues in the evolution and

social group have used this to investigate cultural-specific evolutionary cues to fitness in the context of sexual selection (**McKenzie, McCarty**).

We have invested in a high-performance computing array boasting 300 high-specification multicore CPUs. We have used such resources in two contexts. Firstly, with the emergence of 'big data' in psychological research, computational resources to handle large scale machine-modelling are required. As part of a Consumer Data Research Centre funded project, **Vijaykumar** (UoA3) and **McCarty** are in the process of analysing of a large corpus of Twitter data to explore the conversation surrounding probiotics and their links with health using machine learning. In addition, colleagues researching body image disturbances have used the cluster to render hyper-realistic 3D bodies for their body image work. Such rendering is resource-intensive and has allowed us to render large sequences of body size change very quickly (going from ~2hrs per frame to just a matter minutes).

There are highly specialised facilities associated with two of our research centres. *The Sleep Lab* is a purpose-built two-bedroom en suite facility with a fully integrated kitchen, conference room and lounge and laboratory control room. It has been designed to study and treat disorders of sleep and wakefulness using psychophysiological assessment (e.g., EEG, EMG, EOG, ECG, ERP), indices of basal functioning of the endocrine and immune systems (e.g., diurnal cortisol, cortisol awakening response, cytokines, melatonin), and a variety of signal processing techniques, including power spectral analysis. Each bedroom has Bluetooth connectivity to the control room but there are also facilities to do 'at-home' ambulatory studies. Taken together, these facilities give the opportunity to examine full physiological and sleep/wake parameters over the 24 hour cycle for short or long durations. Not only does this allow descriptive studies to be undertaken on objective markers of sleep quality, quantity, and timing; it also can be used as a diagnostic measure of 'clinically relevant' adverse nocturnal events which impact on sleep and daytime functioning in physically and psychologically ill populations and in patients with neurodegenerative disorders.

The BPNRC houses a clinical testing facility including a wet-laboratory for biological assays (e.g. endocrine, cardiovascular, immune) and other sample preparations; Computer enabled and networked cognitive testing laboratories that encompass: 128 channel Biosemi EEG /ERP facilities (with portable facility essential for clinical work); Near Infrared Spectroscopy; Indirect calorimetry; and Transcranial Doppler; Physical performance laboratories and a Nutrition kitchen (used in collaboration with UoA24).

Finally, the department also has a fully equipped driving simulator with pedals, manual transmission, and force feedback to investigate the negative effects of alcohol consumption on

driving and new work on the possible benefits of aromas in attention (**Moss**); a state-of-the-art stress laboratory equipped to administer a range of laboratory stressors and measure neuroendocrine and well as cardiovascular and other physiological responses using Portapres (Finometer) and PowerLab units (**Wetherell**, **Smith**). We are one of only two institutions in Europe with two Finometers, and the only institution with two Portapres units, enabling ambulatory, beat-to-beat measurement of cardiovascular function; and a range of state-of-the-art eye-trackers (used by various research teams). Faculty based technicians provide support for specialist equipment, and a centralised IT support team provides more general support for researchers, facilitating access to specialised software and applications for research whilst 'working from home'.

In addition to these laboratory facilities, staff and research students have direct access to a 'Digital Commons' within the Psychology building and the 'Research Commons' located in the University's City Campus Library – a mere 40m distant. Library investment in books, journals and databases relevant to this discipline area has almost doubled during the period since REF2014, from £47K in 2014/15 to £89K in 2019/20 (total **£483K**).

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

Strategic Support for Collaboration and Impact

The strategy for building strong translational research highlights the critical role played by external stakeholders, research users and international partners. To facilitate such partnerships, QR funding is made available at both faculty and departmental levels to support travel and networking events, with additional funding made available through our MDRT budgets and via the Research & Enterprise Rewards Scheme. Four Business Development/Customer Relationship Managers in the Sales and Business Development team support staff in finding external partners and developing sustainable relationships through a range of knowledge exchange and impact activities. This team helps to attract strong non-academic partners to ensure relevance and impact of large research proposals (recent successful examples include the BBC, Microsoft and Google as non-academic partners). The team also supports the development of industry-academia collaborations to InnovateUK (successful examples being the collaboration with ThinkCyber described in the Cybersecurity ICS (**Briggs**) and a Knowledge Transfer Partnership with Smyths Toys (**Orme**)). Finally, NUTRAN now offers an important mechanism to promote external collaboration and this multidisciplinary, industry-facing centre forms a key part of our strategy to maximise impact in relation to nutrition, health and wellbeing.

Collaboration and Contribution to the Research Base

Successful large-scale collaborations typically involve European or UKRI funding at scale, with examples from across the laboratories and research groups given below.

Large Scale International and UK wide Research Collaborations

Northumbria psychologists have engaged with six EU funded projects, four within the H2020 programme and these have involved large-scale collaborations across France, Greece, Italy, the Netherlands and Spain, with academic partners including University Degli Studi di Roma La Sapienza, the Universities of Trento and Siena, Valencia and Madrid and TUDelft. Non-academic partners include INRIA, Siemens, Telecom Italia and AXA insurance. Some of the EU projects have involved close collaborations with the European Commission's own Joint Research Centre.

In addition, members of both the Cognition and Neuroscience (**Haigh**, **Myachykoff**) and Health and Wellbeing (**Smith**, **Neave**) groups have been involved in the Many Labs 2 project, labelled "*one of the most ambitious replication efforts in psychology yet*", recently published in *Advances in Methods and Practices in Psychological Science*. The study was a huge replication effort, involving 125 researchers from around the world. **P Cornelissen** was a member of the European Medicines Agency Joint Task Force on Big Data. **Myachykov** and **Taylor** recently secured funding for a 3-year project I-BRAIN funded by European Commission (ERASMUS+), a project that unites 11 universities and research centres worldwide with the aim of developing MRes and PhD tracks in cognitive neuroscience in India and Russia. **Pepper** collaborates with partners in the US (University of California Santa Barbara) and Australia (Edith Cowan University) on a NEScent-funded project on evolution and reproductive timing. **Deary** has been working with scientists worldwide via the Global Consortium of Chemosensory Researchers to investigate the connection between the chemical senses and the COVID-19 virus. Following their letter in the British Medical Journal, the loss of smell (anosmia) was recognised as a symptom of COVID-19.

In further examples of large scale, UK based multi-site studies, **Deary** contributes to the Multiple Symptoms 3 Study, a multi-site randomised controlled trial to test the effectiveness of a Symptoms Clinic for people with persistent "medically unexplained" physical symptoms. Persistent physical symptoms account for at least one third of referrals from GPs to specialists and is therefore likely to yield significant social and economic benefits. The study is funded by the NIHR (£1.2M) and is a collaboration between Sheffield, Newcastle, Manchester and Northumbria Universities. **Moseley** has been involved in a large scale preregistered multi-site study on hallucinatory experiences (HEs), in which general population participants (N=1394, across 11 data collection sites and online) completed assessments of HEs and source memory, dichotic listening, backwards digit span and auditory signal detection tasks, plus a measure of adverse childhood experiences. Findings from this study provide an important step in improving reproducibility in hallucinations research.

This collaborative work is reflected in a steady growth in international co-authorship (moving from 31% of outputs in 2013/14 to 41% in 2019/20) including collaborations with top global universities.

Our most frequent international collaborator is the University of Toronto, Canada (39 outputs), ranked as the top Canadian university and 18th overall in the Times University World Rankings (2020). Our research is also cited in policy documents worldwide, with the USA (27 policy citations), the EU (15) and Australia (12) citing Northumbria's psychology work most frequently (source: Overton).

UK Networks and Network Plus

We encourage strategic involvement with UK wide research networks. For example, **Dodd** is a Co-I on SMARtEN a national research network funded by UKRI that draws together researchers and key stakeholders across the Higher Education sector to improve the understanding of student mental health. During 2019, **Briggs** progressed from her mentoring role in the EPSRC funded Not-Equal Network Plus on Social Justice through the Digital Economy, to head up the project for six months and lead the commissioning of academic/community collaborations around the three challenge areas of Algorithmic Social Justice, Digital Security for All, and Fairer Futures for Businesses and Workforces. In another example, **Deary** leads on a multi-centre UK Biobank collaboration looking at the genetic basis of fatigue and the genetic and phenotypic associations of self-reported tiredness.

Other Academic Contributions and Esteem Indicators

Members of the Unit also contribute to the wider research process through their representation on UK research council panels (e.g. **Coventry, Briggs** for EPSRC funding panels) and overseas (e.g. **Briggs** for Academy of Finland funding panels); societies (e.g. **Smith** is a member of the BPS Research Board); conference committees (see below) and journal editorial boards. Examples of editorial work (for the period 2014-present) includes board membership of The Journal of Experimental Psychology: Human Perception and Performance (**Rajsic, Blythe**), Plos One (**Tovee**), BMC Psychology (**Smith**), Psychology and Health (**Wetherell, Smith**), Journal of Reproductive & Infant Psychology (**Newham**), Nutrition Research Reviews (**Haskell-Ramsey**), International Review of Social Psychology (**Pollet**), Frontiers in Psychology (**Myachykov**), Frontiers in Public Health (**Briggs**), Frontiers in Human Neuroscience (**Bilalić**), Sleep Health (**Ellis**) and Behavioural Sleep Medicine (**Ellis**).

In addition, staff are active in supporting PGR processes at home and internationally, with staff acting as external examiners for, in Asia: University of Hyderabad, University of Malaysia; in Australia: Deakin, Flinders, Monash, Newcastle and Swinburne Universities, in Canada: Carleton University; in Europe: University of Leuven, University of Antwerp, Klagenfurt University, University of Vienna, Tomsk State University, University of Helsinki, National University of Ireland, Galway, University of Limerick, Eindhoven Technical University; in South Africa: University of the Free State, University of Pretoria.

Members of the Unit support the research community not only through their invited conference contributions, but also through their work as International conference organisers. For example, staff gave invited (fully funded) conference contributions and keynotes to the 8th China International Conference on Eye Movements, the 14th Annual Conference on Autism, the International Convention of Psychological Science in Paris, the European Summit on Information Security, the International Society for Evolution, Medicine & Public Health, the FENS European Nutrition Conference and the Sikon Conference in Denmark. Staff have been members of the following conference committees: the European Health Psychology Conference, the European Congress of Psychology, the European Association of Social Psychology, the ACM World Wide Web International Conference Committee, the ACM SIGCHI Conference on Computer Human Interaction, ACM Digital Health and the International Society for Evolution, Medicine & Public Health (Annual Meeting). Awards to staff in respect of such academic citizenship include the BPS Distinguished Contribution to Sport & Exercise Psychology award to **Wolfson** in December 2018.

Contribution to the Economy

Economic impact is realised largely throughout our industry-focussed research, which is carried out throughout the research groups and centres, examples of which are detailed in the impact case studies. Of the three research laboratories, BPNRC works most closely with pharma and nutrition industries globally to conduct full clinical trials around the cognitive impact of diet and nutrition, particularly regarding fatty acids and polyphenols (see dietary supplement ICS). Notable is their work with Bayer consumer care, where Northumbria research on their multi-vitamin/mineral brands has been used in educational materials to train the Bayer medical staff, sales forces and pharmacy staff globally, and also used to generate product specific claims which are put on pack/product websites and/or used in communication to health care professionals and consumers in key markets. Their work also supports product development (for example work with the Mibelle Group has been used to support the launch of their Nepalese pepper product, with Northumbria research cited on their website and in the product brochure).

Economic impact is generated through a number of mechanisms. A two-year Knowledge Transfer Partnership with Smyths Toys (**Orme**, £140K) is designed to develop a buyer decision making support system using machine learning and social media trend analysis to predict market interest in individual toys in order to identify items that will generate high sales. PaCTLab worked with the [text removed for publication] Chain to improve cybersecurity advice and guidance offered to consumers by IT sales staff and with ThinkCyber to improve the behavioural effectiveness of their cybersecurity awareness training. The Northumbria Centre for Sleep Research has been working with Mayborn on two projects designed to create evidence-based toys and clothes for optimal sleep in toddlers.

Contribution to Society including collaborations with health and care organisations

Societal impact is most closely realised through health and wellbeing initiatives. For example, a collaboration with Manchester University (**McInnes**) gives access to the Manchester Brain Bank with the aim of identifying cognitive tests that can predict brain pathology years before it occurs. A publication in Dementia and Geriatric Cognitive Disorders has identified a simple cognitive test of visuospatial episodic memory performed decades before death that can predict the ultimate presence of Alzheimer's disease pathology. **Coventry** conducts participatory/co-design work (in collaboration with PHE) on improving the quality of life with those with HIV, exploring issues around the sharing of highly sensitive data. **McInnes**, **Wetherell** and **Haskell-Ramsay** combine expertise from psychobiology and stress measurement, nutrition and ageing to assess everyday functioning and stress in older adults and to isolate lifestyle factors that may buffer against stress. A two day workshop in Denmark on 'Adaptive Stress Responding' in teachers and carers of those with challenging behaviours, plus regular consultancy on stress identification and measurement in training packages for care providers, has been undertaken by **Wetherell**. **Tovee** and **Cornelissen** have developed an intervention which targets body image disturbance in those with Anorexia Nervosa (AN). This is undergoing trials in collaboration with the University Hospital of the Ruhr-University Bochum for Child and Adolescent Psychiatry and with Radboud University in the Netherlands. Recently, they've attracted NIHR-funding to test its effectiveness with UK adolescents.

Staff are working with the NHS and other health care organisations on UK health and wellbeing initiatives. **Deary's** work has refined the existing cognitive behavioural approach to Persistent Physical Symptoms and has shaped novel health professional training, improving service provision in the North East. Members of the Northumbria Centre for Sleep Research offer advice on managing insomnia in cancer-care, sponsored by Macmillan, and sessions on CBT-I, sponsored by the Northern Pain Network. **Tovee's** NIHR funded **Mapme** project involves a childhood obesity intervention that is being tested with 8,000 families recruited across 12 Local Authorities. **McKenzie** has worked as a member of the expert panel for the Scottish Intercollegiate Guidelines Network which produced the 'Assessment, diagnosis and interventions for autism spectrum disorders: A national clinical guideline' (2016). **Rippon** has worked with Northumberland, Tyne & Wear NHS Foundation Trust with the aim of reducing the use of restrictive practices, such as seclusion rooms, within mental health inpatient settings. **Smith** received funding as Co-I from Tees, Esk and Wear Valleys NHS Foundation Trust to investigate sources of resilience in offender mental health staff. **Thompson** was a co-I on a consultancy project for the North East Leadership Academy (with other Northumbria colleagues) to design, deliver and evaluate development centres and coaching for systems leaders in the NHS.

In terms of ***responding to national and international priorities and initiatives,*** Unit staff have considered the implications of their work for COVID-19, with **Deary**'s contribution to the work on anomia as a symptom providing a prime example. He is a contributor to the British Academy evidence review *The COVID decade: Understanding the long-term societal impacts of COVID-19* (March 2021), providing input to the health and wellbeing policy area. **Jolley** has recently provided evidence to Parliament (Home Affairs Select Committee) on COVID-19 conspiracy theories (with associated work by **Jolley** and **Paterson** just published in the British Journal of Social Psychology). In earlier work on pandemics, **McNeill** and **Briggs** worked with Public Health England to identify factors that lead to the spread of (mis)information on Twitter during the H1N1 (Swine Flu) Pandemic, with a view to improving communication with the public about antivirals and vaccination during future pandemics (they were subsequently invited to contribute to the development of the NHS Digital Strategy). Other new and ongoing work in 2020 assesses the impact of COVID-19 on people with dementia, on those with eating disorders and also on sleep disturbance.

Outside of health, several members of the Unit work closely to ensure their research findings inform social policy, particularly in areas of pressing concern. For example, **Paterson**'s work has informed the Crown Prosecution Service (2017) and she contributed to the All-Party Parliamentary Group's Hate Crime Report (2019). **Coventry** and **Briggs** have worked with the UK's National Cyber Security Centre and the European Commission on the growing problem of cybersecurity and their influence on International and UK policy is documented in an ICS, with dissemination events including a week-long Lorentz workshop (2019) where insurers, cybersecurity professionals and academics came together to discuss the role of cyberinsurance in a more secure Europe.

Public Understanding of Science

A strategic priority is that we continue to maximise the social relevance and impact of our work and engage widely with the public, both in co-designing our research but also in seeking to improve the public understanding of science. We do this through public facing workshops and events, often in association with local and national science museums, but also by engaging with national and international press and broadcast media. In terms of the former, Northumbria has a long-standing collaboration with the Centre for Life, a world-leading science centre and museum where our collaboration led to the development of the Brain Zone, a permanent exhibition funded by the Wellcome Trust that draws upon psychological research on the brain-body relationship and where collaborators include **Kennedy** end **Ellis**. Unit staff have also held public events at the National Science Museum **(McNeill)**, made contributions to the British Science Festival (**Thomas, Briggs**) and the ESRC Festival of Social Science (**Thomas**) and delivered online panel discussions and webinars to world-wide audiences. In terms of the latter, we contribute regularly to *The*

Conversation, where articles by members of staff have had >3 million reads (e.g. **Jolley, Brown**). Several of our staff have contributed to national science public engagement initiatives including Psychology in the Pub, Café Scientifique and the Pint of Science Festival (e.g. **Jackson, Smith**). Our researchers are actively engaged in various forms of broadcast 'education', with accompanying social or print media. An example is **Ellis**'s involvement with the BBC sleep programme 'Goodnight Britain' and his subsequent work on Channel 5's 'The Big Sleep – with follow up articles in the Daily Mail and a national initiative for the public to keep sleep diaries to record the success of the interventions described (see ICS). Our research has been discussed on the BBC One show and has been the focus of dedicated TV and Radio documentaries and podcasts (**Moss, Ellis**, **Wetherell**). Other examples include **Neave** and **McCarty**'s work on sexual attractiveness and 'dancing dads', which was widely reported across broadcast and print media (e.g. BBC, The Guardian and The Telegraph). In 2020, **Jolley**'s conspiracy work was reported by The New York Times, The Guardian, The Daily Telegraph, BBC News and Huffington Post, with an estimated reach of over one million people. Finally, our academics have published books based on their research but that capture the public interest. Examples include the hugely successful 'How We Are' (**Deary**, 2017), 'The One-week Insomnia Cure: Learn to Solve Your Sleep Problems' (**Ellis**, 2017) and 'Making 'Imbeciles' of the Poor' (**McKenzie**, 2020).