

Institution: Bangor University (10007857)
Unit of Assessment: Psychology, Psychiatry and Neuroscience
<p>1. Unit context and structure, research and impact strategy</p> <p>1.1 Structure and context</p> <p>Research in the School of Psychology at Bangor reflects two key approaches with long-established histories. First is the development and application of interventions to promote health and well-being, from early childhood to older age. Developing effective behavioural interventions to improve lives was at the heart of the School's inception more than 50 years ago, and remains central to our research identity today. The second is cognitive neuroscience, where over the past 25 years, the School has invested in staff and specialised research facilities. While the School's four main research groups continue both approaches, this REF period has also seen the School embark on a <i>trajectory of change</i>, described below. As part of this change, all our research groups have been set the strategic goal of promoting use-inspired research.</p> <p>Our research groups are:</p> <p>Interventions for Well-Being (Baker-Henningham, Horne, Hutchings, Morrison, Mullins, Parkinson, Rogers, Saville)</p> <p>The Interventions group investigates well-being, resilience, physical health, and mental health. Some of our work with the greatest societal impact originates from this group, including interventions for children, parents, and teachers to improve children's well-being (Baker-Henningham; Hutchings; Horne); and multidisciplinary interventions targeting functional and psychosocial outcomes of patients and informal caregivers over a range of physical health challenges (Morrison). New approaches to understand public health at regional and national levels use geospatial mapping of mental health experiences, inequalities, and other risk factors (Saville, Rogers). In this REF period, this group has been funded by the MRC, Wellcome, Marie Skłodowska-Curie and NIHR, amongst others.</p> <p>Research in the broad domain of cognitive neuroscience is supported by three groups with overlapping interests.</p> <p>Perception and Action (Bestelmeyer, Boehm, Carey, d'Avossa, Kornysheva, Sapir, Valyear, Watt)</p> <p>This group works to address real-world challenges at the interface of psychology, engineering, biology, and medicine. In this REF period, the group has developed a range of new translational collaborations. These include working with (1) hand surgeons and a developer of upper-limb child prostheses (Ambionics), to better understand effects of, and recovery from, peripheral nerve and limb injuries (Watt, Valyear); (2) clinical neurologists, to understand the neural basis underlying the motor skill impairments in focal dystonia (Kornysheva); and (3) hearing-loss clinicians, to improve the functional utility of hearing testing (Bestelmeyer). Achievements include the first neuroimaging study of grasping with a transplanted hand; decoding of motor intentions from MEG signals; and publication of the Bangor Voice Matching test—the first to allow standardised testing of voice perception. Reflecting the diversity and societal value of this work, funders include Wellcome, Leverhulme, Marie Skłodowska-Curie, and Welsh Government Sêr Cymru schemes.</p> <p>Social Neuroscience and Cognition (Binney, Downing, Koldewyn, Maister, Rauwolf, Turnbull, Ward)</p> <p>This group investigates person perception and social interactions, with the objective of understanding the neural and behavioural mechanisms underlying normal and disordered social</p>

function. In this REF cycle, important neuroscientific discoveries include the central role of occipito-temporal and medial-temporal cortex in visual processing of faces and bodies (Downing); the crucial role of the posterior superior temporal sulcus in children and adolescents for understanding observed social interactions (Koldewyn); and the role of a general-purpose semantic control network in anterior temporal cortex regulating social semantics (Binney). Recent electrocardiographic studies demonstrated for the first time that infants as young as five months have implicit awareness of their bodily states, an interoceptive ability which could be a basis for self-awareness (Maister). Studies of person perception have demonstrated surprising correlations between facial appearance and behaviour, and shown that observers spontaneously respond to these correlations (Ward). The group has been funded by the ERC, ESRC, Ministry of Defence (Defence Science and Technology Laboratory; DSTL) and Welsh Government.

Language and Development (Caravolas, Houghton, Jones, Mills, Oppenheim, Tainturier, Thierry)

Over half the population of Gwynedd and Anglesey are fluent in both Welsh and English, the largest proportion of bilingual residents in the UK (ONS 2019). The language and cultural context of north Wales is therefore a unique driving force for our research. The group seeks to understand language function and use in individuals of all ages, spanning typical and atypical development across mono- and multi-lingual abilities. Important advances include: improving our understanding of the processing strategies used by multilinguals in single and multilingual environments (Thierry); language function and treatment following brain injury in multilinguals (Tainturier); and the development and assessment of vocabulary (Mills) and literacy (Caravolas) in multilingual children. The group's research has also produced novel insights with clear and direct educational and clinical implications, revealing the different learning strategies used by readers with dyslexia compared with typicals (Jones, Oppenheim). This group has been funded by the ESRC, Marie Skłodowska-Curie, and Welsh government.

1.2 Strategic aims for this assessment period

In the REF 2014 cycle, Bangor's School of Psychology addressed key aims including: (1) promoting strategic areas through new hires; (2) investing in our research infrastructure; and (3) supporting multi-disciplinarity and a shift towards maximising extra-academic impact. We can point to success on all fronts, including new hires (Section 2), a new MRI scanner (Section 3), and strategic emphasis on research to improve health and well-being (Section 4).

However, there were important developments post-REF2014, including sector-wide turbulence in Higher Education, and a changing funding landscape increasingly prioritising innovation and impact. Further, retirement and natural turnover meant a loss of several senior investigators. To sustain a vital research environment, we needed to acknowledge and adapt to these realities.

Challenges post REF2014:

1. The School's research base in cognitive neuroscience was built on using new neuroscience methods to drive understanding of fundamental human psychology. However, the distinction between basic and applied research in neuroscience, as elsewhere, is blurring, and funders now seek clearer routes to health and clinical outcomes. We therefore resolved to push our cognitive and neuroscientific excellence further towards work with societal benefits.
2. REF2014 highlighted that the School's impact activity was based largely on our Interventions group, while our outputs came largely from neuroscience. This division was successful in producing both highly-rated research and impact. However, going forward, we judged this division could promote an unhelpful distinction between pure research and applied research with societal value.
3. Promoting real change in research direction is not easy. Researchers have considerable investment in their skill sets, networks, and history of previous success. We must also be careful to preserve the excellence in foundational cognitive and neuroscientific research

that brought us to where we are today. Change must be willing, and cannot happen by fiat from above, nor by a rigid one-size-fits-all approach. Over the cycle, we have recognised that change requires a gradual yet sustained process.

A trajectory of change. In response to these challenges, the School is now on a trajectory of change across this REF cycle and the next. Researchers in our cognitive neuroscience groups are increasingly considering how their work might address key issues of societal importance, and embed principles of “use-inspired basic research”, in which foundational science is informed by real-world problems (“Pasteur’s Quadrant”; Stokes, 1997).

Tools and mechanisms to promote this trajectory. The School’s Executive has implemented an integrated set of policies to incentivise a use-inspired perspective:

1. **Internal Research Review.** Every 2 years the School’s Research Committee tasks researchers with identifying their current and developing research interests, ways their research might develop along use-inspired lines, and an outline multi-year research plan. Researchers receive feedback separate from any PDR or promotion exercise. The Review provides School management with an overview of staff plans and interests, helps align individual faculty with our strategic trajectory, and enables strategic planning, for example, identifying shared developing interests and laboratory requirements.
2. **Incentives for use-inspired projects.** As we describe later (Section 2.1.B), the School provides generous support for researchers, including internal subsidy of facilities and School-funded studentships. The criteria for allocating these resources now include whether the project has potential for societal, as well as foundational, value.
3. **Seed-corn support** for small dynamically configured project teams of staff seeking to answer funding calls or take on new topics aligned with UKRI priorities.

Effects of these policies. An example shows these policies working together. The Internal Research Review of 2016 identified a group of researchers with common interest in recovery from peripheral nerve injuries. Seed-corn funding from the School supported pilot studies on a joint project by Valyear and Watt. This led to new collaborations with NHS hand surgeons from the local University Health Board, Manchester University NHS Foundation Trust, and a local prosthesis innovation firm. In turn, these partnerships generated successful funding applications for EU and Welsh Government PhD studentships, a Wellcome project grant, and an infrastructure grant from Welsh Government, totalling GBP159,000.

The above example is illustrative, and we provide more comprehensive evidence of the success of our approach in the widespread research outcomes benefitting society documented in Section 4.1. We are also proud to submit, as one of our Impact Case Studies (REF3_02), the *Multilanguage Assessment Battery of Early Literacy* (MABEL; Caravolas). MABEL involves cross-linguistic and longitudinal investigations of children’s literacy. As the first ICS to come from our cognitive research groups, MABEL marks an important success in our drive to promote use-inspired research (further detail Section 3.3.B).

1.3 Areas of emphasis

In addition to our key strategic aims, other important issues have required special emphasis over the assessment period.

A. Dedicated academic support for research impact. Promoting research that improves lives requires management structures which increase support for research impact. The School Director of Impact (0.3 FTE), is tasked with identifying promising impact potential, and helping researchers to “build in” impact from the beginning; for example, identifying stakeholders, working with policymakers, and capturing evidence of impact. School support for impact is described fully in Section 2.1.B.4.

B. Interdisciplinary research. Psychology has been described as a hub science (Cacioppo, *APS-Observer*, 2007), and Bangor Psychology has special reach in health, education, and applications of cognitive neuroscience. At a strategic level, we look to develop and widen this reach. Importantly, our position as a major research university in Wales generates unique interdisciplinary opportunities, in concert with other Welsh institutions and partners. These include Wales-only PGR funding streams for collaborative work (Knowledge Exchange Skills Scholarships, KESS; funded by the European Social Fund through Welsh Government), and the new initiative for a Health and Medical School, in partnership with Welsh Government, oriented around prevention, rehabilitation, behavioural change, and data science (REF 5A). Most generally, the trajectory of change as described throughout this document seeks to sustain and expand the reach of our research.

As described in Section 4.1, we maintain multiple joint appointments with the NHS, which facilitate new translational projects in clinical neurology and neuropsychology, such as neuropsychological implications of renal failure (d'Avossa). Our broader research networks, involving the NHS, patient groups, and related charities, let us apply our expertise and facilities in cognitive neuroscience to health and medical challenges including peripheral nerve damage and hand injury (Valyear), dyspraxia (Kornysheva), and hearing loss (Bestelmeyer). In European network projects, we are applying expertise in visual perception towards assessing the perceived realism of new display technologies (Watt). Active collaborations in applied fields have also led to interdisciplinary REF2 outputs, showing how neuroscientific methods can inform neurovascular research on hypoxia and cognitive impairment at high altitudes (Mullins), and the relevance of cognitive psychology and psychopharmacology to addictive behaviours and mood disorders (Rogers).

We are developing reach into public health from multiple directions. Interdisciplinary REF2 outputs use methods from health psychology to inform debates about adherence to medication (Morrison), and geospatial mapping to address the intersections of political psychology and mental health (Saville). Interdisciplinary REF2 outputs seeking to develop, test, and roll out psychologically-informed interventions to promote children's well-being – at scale – benefit from public health research and methods (Baker-Henningham). In education, our researchers and affiliated centres (Section 3.3), work with local schools and aligned local bodies, notably GwE (the School Effectiveness and Improvement Service for North Wales), in the contexts of children's literacy and well-being (Caravolas, Hutchings, Jones). We take advantage of multiple PhD studentship schemes which explicitly prioritise interdisciplinarity (described in Sections 2.2 and 3.1).

C. Research integrity. Bangor University complies with Universities UK Concordat to Support Research Integrity, and has established structures to support effective research governance and ethics. The School of Psychology's research involves volunteer participants recruited from the student population, the local community, and clinical services, and includes vulnerable groups such as children and individuals with psychological or physical illnesses. Consistent with best practice, we seek to protect all research participants and researchers by mitigating risks appropriately while enhancing and monitoring ethical and scientific quality. The School Ethics and Governance Committee reports to the University Ethics Committee, and evaluates researcher plans against relevant ethics frameworks as set out by the NHS, BPS, UKRI and European funders, Bangor University itself, and all appropriate legislation (e.g., data protection). Research ethics training is provided is supported by University courses. The School Committee handles a large number of applications and amendments to approved applications, approximately 200/year prior to lockdown, reflecting the high level of research activity in the School. Beyond the Ethics Committee, our moves towards Open Science, described next, have important benefits to integrity, by promoting replicability and reproducibility.

D. Open science. Within the current REF period, psychology as a discipline has made significant strides towards open, reproducible, and replicable science. The School has responded, recently appointing an Open Science Officer tasked with education and promotion of the increasing open science resources available. We have regular presentations on open

science, including considerations on power analysis; open data sources; and using environments like RMarkdown to ensure transparent data analysis. One measure of success is that half our Category A staff have now used a preregistration service to record their analysis plans and appropriately limit researcher degrees of freedom. We look forward to increasing this percentage over the next cycle.

1.4 Highlights of our approach

Four key factors underlie the vitality and sustainability of our research environment:

1. **A clear and realistic view of our research direction, and identified mechanisms for change**, detailed above.
2. **A leading Postgraduate Research (PGR) programme** (Section 2). School studentship support is extensive and used to provide our faculty with increased capacity for research that is aligned with School priorities. The programme's emphasis on professional development is unique in the UK.
3. **Extensive state-of-the-art research facilities for cognitive neuroscience** (Section 3) including a new MR scanner installation completed in 2019, new and maintained facilities in EEG, multiple TMS and tDCS systems, motion capture, and student, community and neurological participant panels.
4. **Pervasive connections and collaborations with our community** (Section 4), and a sustained pattern of research development moving from *a local to a global scale of impact and improvement to people's lives*.

2. People

2.1. Staffing strategy and staff development

A. Staff and recruitment.

The commitment of Psychology at Bangor to stable and sustainable research success is clear, with 100% of our submitted research staff on permanent contracts. We are a highly international team: more than half of our staff originate outside the UK. We continue to appoint high-calibre staff from top institutions. Within the REF period, we have appointed Valyear (Western/UMiss), Kornysheva (Max Planck/UCL), Binney (Temple/UCSF), Maister (Cambridge/Birkbeck), and Rauwolf (Bath/Oxford) to full-time Lectureships. Consistent with our trajectory of change, appointments push our research in a more use-inspired direction. Valyear and Kornysheva bring expertise in visuomotor sciences, neuroimaging, MEG, and rehabilitation. Binney and Maister extend our reach in social neuroscience and developmental psychology, and strengthen expertise in neuroimaging, neurostimulation, and electrophysiology. Rauwolf is an ECR and our most recent appointment (Dec 2019), who applies computational and AI models to decision-making, shared resource management, and sustainability. Through recruitment and promotion, we have established and maintained a healthy balance of research faculty across seniority (12 Professor; 10 Reader/SL; 8 Lecturers).

B. Support for researchers

B1. Time. Research time is protected by careful management of teaching workloads. Category A staff typically teach a single Level 6 or 7 module per year, aligned with their research expertise. In a large School (1096 students in 2019-20), this protection is only possible through innovative structural organisation. BPS and core teaching are provided by the School's full-time Teaching and Scholarship staff (FTE=20). These teaching professionals (including two National Teaching Fellows and 19 Advanced HE Fellows) all have doctorates, permanent contracts, and a parallel and viable lifetime career structure (10 Lecturers; 1 NHS consultant joint appointment; 8 Reader/SL; 1 Professor). Their focus on teaching excellence is evidenced by consistently high student satisfaction, e.g., 95% in the 2020 NSS.

B2. Space. The School offers bright and modern working areas, with single-occupancy offices, and large kitchen areas on each floor providing social spaces. Our main building holds our newly

updated MRI scanner, TMS facilities, food and psychopharmacology labs, and accessible testing areas for children and patients. A second building houses the majority of standard cognitive neuroscience labs, with 1067 m² lab space available.

B3. Internal funding and resources. Internal support takes many forms, most significantly, School-supported PhD studentships (described further in Section 2.2). We also make internal funding available for all of our state-of-the-art shared research facilities, including fMRI, EEG, and TMS labs (Section 3.2). Staff winning overhead-bearing grants are allocated 15% of overhead funds to manage travel, equipment, and testing needs. The School further offers research fund payments (GBP250-GBP1,000) to acknowledge and incentivise grant submissions, and to help bridge between grants. Particularly demanding administrative roles (e.g., Director of Postgraduate Studies) attract annual payments to overhead accounts for research support. Over the REF period, approximately GBP1,500,000 was spent through these personal research accounts.

B4. Wide-ranging support for staff working on impact. We support research impact in many ways. First, we fund school-based internships and research posts to accelerate impact activity (e.g., developing Twitter networks to promote and monitor instrument use, Caravolas). Second, we secured significant funding for impact development through the University's ESRC Impact Accelerator Award. During this REF period, GBP332,000 of these funds were awarded to researchers in the school, supporting a dozen different projects and all our submitted impact case studies. Third, we arrange workshops to meet with policymakers and third-sector leads and administrators to explore and, where effective, align impactful work with policy objectives, especially in the fields of health and education (e.g., mindfulness, parenting). Finally, time spent developing impact is properly considered within our quantitative workload model (see REF 5A). We recognise periods of intense impact activity can require time away from the School, or focussed attention on a project, and therefore provide short-term teaching and administrative 'sabbaticals' (Baker-Henningham, Caravolas).

B5. The research community. The School hosts regular Research Away Days, an active colloquium series (hosting 154 speakers from the UK, Europe, and globally over the non-lockdown REF period), and internal research and methodology groups where ideas for grants and projects are presented. The Head of School holds monthly updates to keep staff informed about research activity and events across the School. Our core faculty are complemented by international visiting Fellows, including visitors from the University of Udine, Italy; the University of Bologna, Italy; the State University of Utah, USA; and the University of Missouri, USA. These visitors were funded internally or by external sources such as the Leverhulme Trust and the Marie Skłodowska-Curie fellowship programme.

B6. Mentoring and training. In addition to the University mentoring scheme, academic staff are assigned a senior School mentor for advice and support on all aspects of academic life. Senior staff in key roles are provided University-funded training in leadership and management. Category A staff attend a yearly PDR with the Head of School or other senior academic. Grant applications from conception to submission are subject to rigorous peer review. In fact, our grant incentive scheme (2.1.B3 above) requires evidence of peer review. Staff are actively encouraged to present new research ideas and grant proposals for constructive feedback at one of our many internal series.

B7. Specific additional support for new hires and Early Career Researchers (ECR). New research faculty are provided with start-up funding, equipment, lab space, and a guaranteed School-funded PhD studentship. Where needed, we provide technical support for new research facilities such as bespoke kit for use with MRI, and EEG for infant testing. For those using our in-house MRI, we provide GBP10,000 of scanner time per year for three years. New staff typically do not begin teaching until their second year. We have introduced an ECR Mentoring Lead role, in tandem with University-wide initiatives, with the aim of identifying and meeting key ECR needs. Our support policies align with the Researcher Development Concordat for ECRs. New

staff are given particular support during their probation to ensure these requirements are met; all Category A appointments during this REF period progressed successfully.

2.2 PGR training, supervision, and support

Crucial to the School's research vitality is our PGR programme. Our aim is that all research faculty have at least one PhD student or postdoc in their labs, and we have kept close to this goal (over the past 5 years, at any one time ~80% of research faculty have had one or more people in their lab). To make this happen, we invest heavily in School-supported studentships, and academic support for the students.

Note our reported total of 185 doctoral degrees includes 75 professional doctorates from the NHS Health Education and Improvement Wales-funded DClinPsy programme. Unless indicated otherwise, this document refers specifically to our PhD students and programme.

A. Core aspects of the PhD programme.

The School manages a large and well-developed programme for PhD supervision and training. Over the REF period we enrolled 82 FT and 9 PT PhD students (School funded: 33; KESS: 11; ESRC: 11; Coleg Cymraeg: 2.5; ERC/EU: 4; Welsh Government: 2.5; Self: 10; Other: 13.5), and achieved a 4-year completion rate of 74%. Over this cycle we awarded 105 PhDs, maintaining PhD activity at 15 awards per year for this cycle, as compared to 14 per year for REF2014. Internal spend for PhD support over this period was GBP1,860,000, approximately half of the School's non-pay budget.

We participate in multiple studentship funding programmes that support collaborative and interdisciplinary research, including: the ESRC Doctoral Training Partnership (DTP) psychology pathway (with Cardiff, Swansea); the School-led DTP bilingualism pathway, which is explicitly designed to support interdisciplinary work involving psychology, linguistics, and education, and which reflects our special interests in how people learn and use multiple languages; the European Social Fund-supported KESS programme, connecting academic research capabilities to companies and 3rd sector organisations; and membership of two Marie Skłodowska-Curie Innovative Training Network consortia (Section 3.1). Studentships on these programmes have reflected collaborative and interdisciplinary research, including improving numeracy in at-risk children, threat perception in police work, and perceptual responses to new display technologies. Half of our collaborative REF2 outputs (excluding from our new hires) were co-authored with current or former PGRs.

B. Distinguishing features of the PhD programme.

PGR training outlets in the UK are expected to provide appropriate supervision and mechanisms for development. Here we describe highly distinctive features of Bangor's programme, some unique in the UK.

B1. PhD Professional Development. The School has developed an innovative programme to ready our PhD students for a competitive job market:

1. Twice-yearly PGR research conferences, one exclusive to the School, the other with allied PGR in health, medicine, education, and sports science.
2. A weekly PhD colloquium run by students for students, allowing PGR and postdoctoral researchers to share experiences, research outcomes, and skills, in a low-key, supportive environment.
3. A mandatory professional development series, taught by senior staff. Over a 2-year period, seminars and workshops are given on grant writing, job markets, open science, high-impact publishing, and diversity issues in academia and science. PhD students meet visiting psychologists and neuroscientists working in industry, government, and academic publishing.

B2. Training PhD students for teaching in Higher Education (HE). The School has developed two mandatory one-year modules to train our PhD students how to teach in HE. This training upskills our PhD students, while improving the learning experience of our UG students. Teaching and marking loads are tightly controlled, as part of a teaching portfolio compiled over two years. The portfolio is then the basis for an optional module, leading to an accredited teaching qualification (Associate Fellowship of Advance HE). Since 2016/17, nineteen Bangor Psychology PhD students have received Associate Fellowships by this route. To our knowledge, the accreditation offered by our programme is unique, and we believe qualifies it as one of the strongest programmes for PhD training in the UK.

B3. Access to specialist facilities. Access to cognitive neuroscience infrastructure and facilities for PGR students is first class. We offer a hands-on level of access to MRI, TMS, and EEG facilities. We provide documented pathways for PGR students to achieve independent operator status, in the same way as research-active staff. MRI operator status for PGRs requires significant training investment unusual in UK psychology departments. In 2019, for example, we granted 14 Level 2 (main operator) qualifications, half of which were PGRs; and 30 Level 1 (support) qualifications, which were almost exclusively PGRs.

B4. External indicators of PGR-programme success. The success of our PGR programme is further evidenced by the latest Postgraduate Research Experience Survey (Question 18.1, PRES 2020, which includes DClinPsy): 91% of our PGR students (71% response rate) agreed they are satisfied with their overall PGR experience, 11 points above the sector average.

2.3. Support and promotion of Equality and Diversity (E&D)

We are committed to all aspects of equality, diversity, and social inclusion, as embedded in the mission statement of Bangor University, and most certainly as they apply to our research, research funding, and access to infrastructure. Responsibility starts at the top: the Head of School is tasked with ensuring members are aware of and comply with university policies including equal opportunities, harassment and bullying, and Welsh language use. Perhaps more important however, is creating a broader "nurturing" culture, to ensure equal opportunity is supported and fostered throughout the School. Central to this support is the role of "E&D champions" who have the responsibility to promote engagement across all academic Schools and service departments, and liaise with the School Executive to facilitate continuous improvement.

Mechanisms for addressing E&D issues.

Staff and students have multiple ways to safely raise E&D issues: with School management; University management and HR; E&D champion; or through a personal tutor (PGR) or mentor (staff). Through whatever route a concern is raised, the next step is for the School Executive and E&D champion, potentially in consultation with HR and University management, to consider remedies and potential policy changes. An example of this mechanism in operation is that E&D concerns raised by students led to the introduction of free-form fields for experimental participants to self-identify their gender. To date, we have not had any staff E&D complaints. However, we have implemented a number of staff suggestions raised through the strategic review process, described next, indicating that staff are engaged with E&D.

Strategic review.

All aspects of School decision-making fall under the remit of E&D consideration. Therefore, School Executive and the E&D champion annually review school processes with regard to E&D initiatives. One key aim of the review is to ensure School support is allocated equitably across staff. This is particularly important because we offer so much researcher support (Section 2.1.B: time, teaching loads, space, internal funding, studentships, impact support, mentoring, early-hire support, access to shared and investigator-led facilities). Bangor Psychology has held a Bronze Athena Award since 2015. We were commended in our most recent Athena Swan application process, for having at least one member of the School's Athena Swan Self-Assessment Team

sitting on every committee across the School. Additionally, the chair of this Team sits on the School Executive.

To give concrete examples of improvements delivered by the strategic review: while it has been established procedure for standing committees to comprise a mixture of protected groups, we now ensure that short-term interview panels, selection committees, and task-and-end groups also represent this diversity. Our PGR Professional Development Series (see 2.2.B1), is another example, in which staff proposed sessions on gender and career. This topic is now delivered by female research staff at all levels of seniority as part of the required Professional Development Series for PGR students (and open to all staff).

3. Income, infrastructure and facilities

3.1 Research funding

The final years of the REF2014 cycle and the early years of this cycle saw the departure of senior researchers who contributed substantially to income in REF2014. Their departure accounts for much of the drop in research spend reported here. As noted above, our new hires for this REF cycle (Section 2.1.A) constitute a generational transition towards PIs early in their career. As shown below, they are already contributing to School income as they establish their research groups. Now, following a reduction in annual research spend from GBP2,186,000 for 2013/2014 to GBP808,000 for 2016/2017, spend is steadily growing again, reaching GBP1,368,000 for 2019/2020. Overall, the School's research spend for this REF period comes to GBP9,497,000.

Major and prestigious grant awards.

Funders are diverse and include: Wellcome, Leverhulme, MRC, ESRC, Royal Society, British Academy, British Council, ERC, Horizon2020, World Bank, as well as Welsh Government, Ministry of Defence, the local University Health Board, schools, and businesses. Funding figures quoted reflect funded award values to Bangor unless explicitly stated otherwise. EU funding has been strong and includes two ERC Starting Grants (Cross, social perceptions of robots; GBP1,248,000; and Koldewyn, perception of social interactions, GBP1,157,000), and membership of two Marie-Curie Innovative Training Network consortia (ENTWINE, Morrison, on understanding challenges in informal caregiving; GBP203,000) and RealVision (Watt, aimed at creating ultra-realistic digital images; GBP202,000). Four new hires in this REF cycle (Section 2.1.A: Binney, Kornysheva, Maister, Valyear) have already secured six small grant awards (from the Royal Academy, Wellcome Trust, Welsh Government Sêr Cymru III; combined GBP209,000) to prepare for applications to larger schemes.

Other notable awards sustain our commitment to developing effective health interventions, especially in children. An NIHR-funded and Bangor-led multi-centre Randomised Controlled Trial evaluated the effectiveness and cost-economics of an anti-bullying intervention (Hutchings with partners in Oxford, Exeter, Warwick and Cardiff; full worth GBP1,847,000 with a value to Bangor of GBP485,000). A series of awards, led by Baker-Henningham at Bangor and at the University of West Indies (UWI), address childhood educational and health challenges in low- and middle-income-countries. These awards support a Bangor-led and MRC-funded cluster-randomised trial to address teacher and parenting violence in Jamaica, and projects funded by the British Academy and the International Centre for Diarrhoeal Diseases to improve early childhood health in Bangladesh. The full worth of these awards is GBP2,262,000 (GBP219,200 value to Bangor), and developed the impact described in one of our Impact Case Studies (REF3_01). We secured EU-support to address the prevention of child mental health problems in South-Eastern Europe (Hutchings; GBP87,000). Also notable is an ongoing MRC Development Pathway Funding Scheme Award, with Oxford and Vancouver, to investigate the therapeutic potential of a lithium-mimetic for impulsive behaviour (Rogers, full worth GBP1,200,000 with GBP602,000 value to Bangor).

3.2. Research infrastructure and facilities

We continue to invest in and operate a diverse and modern array of open-access and investigator-led facilities, particularly in cognitive neuroscience.

A. Shared, open-access facilities.

Shared facilities are available to all staff and PGR students. Access is fully subsidised for staff without external funding for internally approved projects. The School's Research Committee provides high-level oversight and management, including review of operating procedures and usage assessment.

A1. Research-dedicated Philips Elition 3T MRI scanner. Bangor's new MRI scanner was installed in summer 2019 (GBP1,362,000 over seven years), driven by the need to grow our imaging capabilities in line with the University's revitalised medical and health research agenda. Located in the main Psychology building, the new scanner replaces our previous Philips scanner and is a major upgrade in terms of increased signal-to-noise, improved spatial and temporal resolution, multi-band and multi-echo sequences, and a full suite of structural and metabolic mapping tools. Our scanning unit additionally includes MRI-compatible eye-tracking, capacity for in-scanner EEG recordings, and a nearby mock scanner to support training studies and work with children. Scanner access is managed through a systematic and transparent process of internal peer-review and project approval by the Unit's Steering Group. We ensure that our staff, in preparing grant applications, can access this facility, and have provided 1,500 hours of internally-funded scanner time in this REF period with a nominal GBP800,000 full economic cost. Supported projects produced datasets leading directly to funded grants from ERC, Leverhulme Trust, and Wellcome Trust.

A2. MR-guided TMS and tDCS brain stimulation. The School houses multiple magnetic stimulation systems, including high-frequency repetitive and paired-pulse specialised systems; multiple coils, including a double-cone coil for deep brain stimulation; and Brainsight neuro-navigation for functional and anatomical MRI-guided TMS coil localisation. Our neuro-navigation lab benefited from an upgrade during the REF cycle via joint Royal Society and School funding.

A3. Open-access EEG facilities. The Psychology Open-access Electroencephalography and Topography (POET) lab provides high-density EEG recording in a fully shielded environment, with synchronised remote eye-tracking. Currently, the POET lab is used to investigate a diverse range of topics: machine learning to predict motor sequences from EEG activity (Kornysheva); social development and self-perception in infants (Maister); and development of single-trial EEG analyses to compare language processing in typical and developmentally challenged groups (Jones and Oppenheim). This facility supported recent grant applications to the ERC, ESRC, and AHRC.

A4. Online-testing. The School holds site licensing for Qualtrics and Pavlovia platforms. At the beginning of lockdown in March 2020, we appointed a School online-testing champion to support staff in moving their research online.

A5. Participant panels. Just as important as equipment is access to participants, and our research infrastructure includes **general and specialist participant panels**. The School supports a large student cohort, allowing ~4000 hours of student participation for course credit every year. We also maintain specialised participant panels, most notably our **neurological patient panel**, run by D'Avossa who holds appointments in Psychology and the NHS. This panel gives us access to highly-informative selective lesion cases (e.g., Stanciu et al., *Journal of Neuropsychology*, 2019, submitted REF2), and capacity for neuropsychological research. A recent development since 2019, in cooperation with our Miles Dyslexia Centre, is a **learning disorders panel**, focused on dyslexia and other learning disorders in adults. We also maintain a **community participant panel**, particularly for recruiting matched controls for patient case studies, and for providing a pool of bilingual Welsh/English participants.

B. Investigator-led facilities.

Research faculty have dedicated and highly specialised lab and testing space as required, including: EEG labs additional to our open-access facility (Thierry, Mills); two sound-proofed labs for auditory studies (Bestelmeyer, Oppenheim); virtual-reality (VR) and augmented-reality (AR) robotically controlled force-feedback systems (Watt); mobile eye- and pen-tracking for studies of literacy development in schools and the lab (Caravolas); a food and psychopharmacology lab (Rogers); video analysis suite for children's cardio-respiratory fitness and fundamental movement skills (Horne); and a 12-camera system for capture of complex full body and limb motion, and capabilities for integrating with body-worn "actigraphy" data (Valyear, Watt).

C. Technical research and design/build support.

Our MRI Unit is supported by a dedicated technician (1.0 FTE). Other technical support (shared with researchers in health and sports sciences) includes 1.5 FTE research technicians, and 2.0 FTE electronic- and mechanical-engineering technicians to assist with specialised and bespoke experimental hardware and software. Recent illustrative examples of bespoke projects include custom timing hardware for TMS, an fMRI-compatible guitar, and specialised food-dispensing machines.

3.3 Infrastructure use in relation to impact

As discussed in Section 1, we are committed to reducing distinctions between pure research and applied research with societal and academic impact. All our research facilities are therefore fully available to researchers pursuing both impact and more basic approaches.

An important and long-standing organisational infrastructure within Bangor Psychology, and self-funding engine for generating impact, lies in several centres sitting within the School that are focused on translating research into practice. Some of these centres were referred to in REF2014 as "associated units". Partial devolution of their governance and operation allows these centres the freedom to pursue specific impact-driven missions, while at the same time benefitting from the wider context of the School's research support. Each centre operates on a tripartite basis: theoretically-driven research; research on the factors influencing implementation; and stand-alone services such as training or roll-out of rigorously tested programmes. The effectiveness of this infrastructure is seen in the reach of the centres and their value for research impact.

A. The Centre for Evidence-Based Early Intervention, led by Prof Judy Hutchings OBE, develops and evaluates programmes to improve childhood experiences for those with behavioural difficulties. Working with its linked charity, the Children's Early Intervention Trust, the Centre makes training and resources in tested programmes available to schools. In the REF period, the Centre has trained over 1700 programme leaders and teachers across seven programmes, supporting approximately 22,000 children worldwide.

B. The Miles Dyslexia Centre is a self-financing, nationally and internationally recognised Centre active in research, intervention and assessment of dyslexia and other developmental learning conditions. The Centre's mission includes public engagement on dyslexia and developmental learning conditions; practitioner training for work with dyslexic children (810 attendees from local schools and organisations since 2015); specialist teaching for school children; and basic research into developmental learning disorders, conducted through our Language and Development research group. The Centre is currently leading UK research on remote instruction of language and literacy (Jones), funded by the ESRC and Welsh Government. This programme has been prioritised for rapid roll-out, reaching 200 students and 16 schools since lockdown. Literacy screening and assessment is now delivered through the multi-language assessment tool (MABEL) described in our Impact Case Studies (REF3_02), resulting in mutual benefit to MABEL and the Centre. MABEL is particularly suited to the bilingual context of local schools, while the Centre's assessment provided a valuable

development platform for MABEL. The Centre also works to deliver British Dyslexia Association-approved practitioner training for MABEL to Wales, England, and internationally.

C. The Centre for Mindfulness Research and Practice provides leading professional training for mindfulness-based teachers, while developing a rigorous evidence base. Its director, Crane, and her team, have led the development of tools and criteria to assess the competence of trainee mindfulness teachers, as described in our Impact Case Study (REF3_03). The Centre offers a Master's in Mindfulness (intake 45 students per year) and maintains a licence agreement with Bangor University enabling The Mindfulness Network to deliver Bangor IP globally in the form of CPD courses. For the 2019/20 period, the University and The Mindfulness Network combined to deliver >20,000 hours of training to over 600 participants.

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

4.1 Our research contributions to the community, economy, and society

The *trajectory of change* identified in Section 1 places fresh emphasis on how our research benefits society. Here we identify a range of contributions.

A. Context.

Bangor University is situated in a semi-rural setting of generally lower socio-economic status. As the only university in a 60-mile radius, we have a particular value and responsibility to our local economy and community. Our researchers work to deliver research benefits through a network of local schools, charities, health boards, businesses, and other community partners; as well as Welsh Government in policy-relevant research. As detailed below, many of our contributions relate to mental and physical health and well-being. But other key research themes arise from Bangor's specific context. The importance of interventions to promote children's health are magnified in a region with longstanding deprivation and health and economic inequalities. The cultural and linguistic context of north Wales also makes multilingualism and cultural identity another pivotal focus, addressed by our Language and Development research group (Section 1.1).

B. Research collaborations in our local community

B1. With local innovation and service providers. Multiple ongoing projects seek to improve mental health and well-being, using principles of positive psychology and mindfulness-based approaches, applied to specific contexts. Work with Rhyl City Strategy, supporting local employment, develops and delivers training aimed at improving the positive wellbeing of long-term unemployed (traditional non-responders), as well as the success of those in work but struggling. We also work with North Wales Police – a large force comprising 1,500 officers and covering 6290 km² – to improve the decision making and mental state of officers, exemplified by a multiyear contract to deliver mindfulness courses (see 3.3.C).

In line with Welsh Government's policy frameworks ("A Healthier Wales", "Let's Get North Wales Moving"), we are working with local schools and aligned bodies (e.g., GwE) to support parents and to improve children's diet, health, and well-being. Much of our work in this domain has benefitted from support of the ESRC Impact Acceleration Award (Section 2.1.B4): promotion of anti-bullying interventions and conferences; production of media and websites for physical activity in children; and practitioner workshops for understanding handwriting difficulties in children with dyslexia and Developmental Coordination Disorder. We provide remote literacy tuition, for both typically developing and dyslexic children in north Wales (Section 3.3.B).

Postgraduate opportunities through the Knowledge Economy Skills Scholarship scheme allow us to work on movement-science inspired approaches to peripheral nerve injury and repair with the local health board; and in collaboration with local councils in Wales and the Midlands we seek to improve the choice architecture of school canteens and facilitate healthy eating choices by children.

B2. With the NHS. The School develops and maintains an extensive network of relationships with **Betsi Cadwaladr University Health Board (BCUHB)**. BCUHB is the largest health board in Wales, serving a population of 648,000 people (StatsWales). Mullins is Vice Chair of the NHS Research Ethics Committee, where D'Avossa also serves. Saville and Rogers are members of the Academic Partnership Board for the Mental Health and Learning Disabilities Division of BCUHB, alongside NHS clinicians, research administrators, and other academics. That group is charged with fostering links and collaborations between BCUHB and research staff. Further afield, we have research partnerships with St George's University Hospital London (dystonia), and Manchester University NHS Foundation Trust, Wythenshawe Hospital (hand surgery).

Joint-appointments between the School and local Health Board ensure ongoing collaborations and outcomes in neuropsychology, clinical psychology, and mental health. D'Avossa is an Honorary NHS Neurology Consultant who oversees our neurological patient panel. Parkinson sits on the Research and Innovation Strategic Partnership Board of BCUHB which brings together stakeholders across academia (Bangor, Glyndwr, Chester, Aberystwyth) and health boards to support research collaborations that are aligned with the BCUHB strategic plan. Turnbull has an honorary clinical position with BCUHB, and Chairs the Academic, Education and Information Group of the North Wales Neurosciences Board. We also have close links with the North Wales Brain Injury Service, via jointly-appointed specialist clinical-academic staff.

Clinical partnerships are further facilitated through the North Wales Clinical Psychology Programme (NWCPP, hosting our DClinPsy programme). The NWCPP includes six joint Bangor University/Board appointments, and indeed the depth of NHS collaboration was singled out for commendation in the most recent BPS reaccreditation. Research projects undertaken as part of the Programme's activities focus on addressing BCUHB's pressing needs and strategic priorities, such as: developing approaches for achieving a sustained recovery from drug and alcohol addiction; reducing suicide and self-harm behaviour in the context of borderline personality disorder with Dialectical Behaviour Therapy; and using estimates of social capital to predict variability in psychiatric admission rates across Wales, with an impact on the planning and remodelling of psychiatric inpatient wards.

Our collaborations with BCUHB go beyond mental health and clinical psychology, to include new forms of research and impact projects for this cycle in: *audiology*, working to improve hearing tests and interventions for hearing-impaired individuals, seeking to improve *caregiver experiences*; scoping the risk of *gambling harms* across Wales, and providing the first national geospatial map of risk factors to produce a set of policy recommendations that have guided Welsh government policy developments (with Public Health Wales); hand surgery and assessing impaired hand sensation in *peripheral nerve injury*; collaborations with the Speech and Language Therapy unit for multilingual *language assessment and treatment following brain injury*, including development of a web-based assessment tool. Many of these new health service collaborations come from our cognitive neuroscience groups, further demonstrating the trajectory of change outlined in Section 1.

In response to the Covid crisis. As part of its evidence-based strategy, the Welsh Government established a Technical Advisory Group along with associated subgroups to provide input to decision-making on Covid policy. Parkinson is one of three expert academic advisers on the Risk Communication and Behavioural Insight subgroup advising on non-pharmaceutical interventions to reduce transmission, and the longer-term behavioural response to the Covid pandemic. As a result, he is now delivering behaviour-insights training to all tracking teams in Wales alongside colleagues in Public Health Wales. Mullins and d'Avossa are members of the CNS SARS-Cov2 Consortium, an international partnership between the Alzheimer's Disease Society and academic clinicians and researchers across four continents, whose aim is to harmonise epidemiological protocols to characterise the neuropsychiatric sequelae of long Covid.

C. How we develop research impact: From local to global

Some of our most societally-relevant research is driven initially by *local* needs, concerns, and priorities, and then accelerated to create national and international impact. We would like to draw attention to examples of this pattern of accelerated scope.

1. The *WHO Parenting for Lifelong Health for Young Children* programme, designed to prevent violence in low-resource settings, was built on early work from the Centre for Evidence Based Early Interventions with local Child and Adolescent Mental Health teams in north Wales. In collaboration with colleagues from Cape Town University, Oxford University and UNICEF, this programme was adapted and implemented globally in the Czech Republic, Democratic Republic of Congo, Eswatini, Kenya, Lesotho, Malawi, Montenegro, North Macedonia, Philippines, Republic of Moldova, Romania, South Africa, South Sudan, Tanzania, and Thailand.

2. The *Food Dudes* programme was originally developed and trialled in Bangor schools. It has since been delivered to a staggering 1.6 million children worldwide, 1.1 million children this cycle, and adopted nationally in Ireland. These successes have led to formal advisory contributions by the School to the World Bank, UNICEF, and USAID; and to the Irish Government to lead development of new Food Dudes videos, materials and protocols to ensure cost-effective and high-fidelity delivery of the Programme in Irish primary and special schools.

3. Measures and training interventions to promote the resilience and well-being of the long-term unemployed in Rhyl were, with the support of the British Council, subsequently integrated into the mental health provision of NGOs across South Asia, including India, Afghanistan, Sri Lanka, Nepal, and Dubai.

4. The complexities of assessing the literacy of bilingual children in north Wales has led to the extensive use of MABEL in both basic research and practice, through our Miles Dyslexia Centre (both MABEL and the Centre discussed in Section 3.3.B). This multilingual use of MABEL has now expanded internationally to other multilingual contexts using Czech, Slovak, Spanish, and English.

5. As described in Section 3.3.C, expertise gained by our Centre for Mindfulness Research and Practice in local delivery of training for mindfulness instructors led to the research and development of tools and criteria to assess trainee competence. The high-quality instruction developed and trialled at Bangor was then rolled out globally as the gold-star standard of training for practitioners (Crane), and led directly to an Impact Case Study (REF3_03).

D. Public engagement.

We engage with the public at local, regional, national, and international levels. Locally, Bangor Psychology staff members gave public lectures and demonstrations (e.g., Bangor Science Café, the University's Pontio Arts and Innovation Centre, Bangor Science Festival, Festival of Discovery Wales). Staff have consulted for and appeared on BBC and S4C science programmes. Bangor staff and students also engage with the public on a wider national and international stage. For example, Kornysheva was recently awarded a Guarantors of Brain *Public Understanding of Neurology* grant. Staff and PGR students regularly contribute to Soapbox Science events and online venues, including widely-read articles for *The Conversation* (articles by our staff this period racking up over 3.5 million views). We are also working with other professions to communicate principles of psychological science in professional contexts, such as at HM Prison Berwyn.

4.2 Our contributions to the discipline and the research base**A. Advisory roles**

Actif Woods Wales (Morrison); British Association of Mindfulness Based Approaches (Crane); Health Education England (Crane); Mindfulness Institute (Crane); Public Health Wales (Morrison); Research panel to the Responsible Gambling Strategy Board/Gambling Commission

(Rogers); Welsh Government (development strategies for Wales; Crane and parenting; Hutchings); faculty member of MRC Applied Global Health Board (Baker-Henningham). Several staff members also have roles in charities, including as a Trustee of the Mindfulness Network (Crane), Director of Training in Children's Early Intervention Trust (Hutchings).

B. Professional Society Leadership Roles.

European Health Psychology Grants Office (Morrison); European Health Psychology Scientific Committee (Morrison); Fellow of Psychonomic Society (Oppenheim); Fellow of American Psychological Association (Mills); British Neuropsychological Society Committee (Binney); Research IN Touch (Valyear); Sensorimotor Learning Network (Valyear).

C. Conference committee membership and workshops.

International GABA MR Spectroscopy Meeting 2016 (Mullins); ISMRM MR Spectroscopy Workshop 2016 (Mullins); MRS techniques for neurometabolite measurement 2018 and 2020 (Mullins); Phoenix International Research Ethics Seminar 2020 (Mullins); Organisers for the International Conference on Cognitive Neuroscience of Second and Artificial Language Learning (Thierry; Jones); programme committee for International Conference On 3d Immersion (2012-present; Watt); session organiser Neural Control of Movement conference (Kornysheva); workshop on artificial haptics, Eurohaptics 2020 (Valyear, Watt); organising committee for International Neuropsychanalysis (2000-present; Turnbull).

D. Funding and Grant Review.

NIHR HTA (Morrison); RfPB (Morrison); MRC (Mullins, Baker-Henningham); Grant review: Royal Academy of Engineers (Mullins); EPSRC Peer Review (Mullins); Wellcome (Mullins); Fund for Scientific Research (Mullins); ESRC Peer Review College (Jones, Ward); British Academy (Koldewyn); Leading Fellows (Koldewyn); Israeli Science Foundation (Koldewyn); Strength-in-Places/InnovateUK (Rogers); Carnegie Trust (Ward); Agence Nationale pour la Recherche, Paris (Thierry); Science Foundation Ireland (Thierry); Natural Sciences and Engineering Research Council of Canada (NSERC, Kornysheva); German Research Foundation (Kornysheva, Maister); Human Frontiers Science Program (Kornysheva).

E. Journal Editorial boards.

Associate Editors: *Brain Research* (Carey); *British Journal of Health Psychology* (Morrison); *Cortex* (Carey); *Laterality* (Carey); *Language and Cognition* (Oppenheim); *Language Learning* (Thierry); *Mindfulness* (Crane); *Neuroreport* (Thierry); *Global Advances in Health and Medicine* (Crane); *International Gambling Studies* (for Europe, Rogers). Consulting/review Editor: *Journal of Experimental Psychology: Human Perception and Performance* (Watt). Editorial board: *Journal of Gambling Studies* (Rogers), *Neuropsychanalysis* and *Journal of Neuropsychology* (Turnbull). Consulting Editor: *Journal of Cognitive Neuroscience* (Kornysheva). International advisor: *Mindfulness* (Crane).

F. Collaborative and interdisciplinary PGR training networks.

Morrison and Watt were both awarded Marie Skłodowska-Curie International Training Network awards to establish multi-disciplinary graduate training networks in the areas of Caregiving in different countries and creating hyper-realistic 3D imagery, respectively. Our Head of School (Bowman) serves as programme leader (2018 – present) for our doctoral training programme for Continuous Professional Development as approved by Advance HE. Our position as one of the major research universities in Wales also generates unique opportunities to attract research income in concert with other Welsh institutions. These include the KESS scheme (led by Bangor University), which funds PhD studentships in partnership with local SMEs, and the ESRC Wales Doctoral Training Partnership, in which we contribute to both the Psychology and Bilingualism pathways.

G. Fellowships and awards.

In this REF period, contributions of several of our staff have been recognised by the award of prestigious research fellowships. Binney won a Welsh Crucible award for ECR and the 2020

Elizabeth Warrington Prize from the British Neuroscience Society. Morrison was awarded Fellowships of the Royal College of Physicians in Edinburgh, and the European Health Psychology Society. Rogers was elected Fellow of the Learned Society of Wales in 2016. Hutchings was made an Honorary Fellow of the British Association for Behavioural & Cognitive Psychotherapies, and was awarded a Lifetime Achievement Award from the British Psychological Society.

4.3 Our approach to research collaboration

Research collaboration with academic and non-academic colleagues is a recurring theme in this document. Throughout we have described and evidenced multiple arrangements for collaborative research. At a strategic level, we develop and promote a variety of formal and informal networks that provide access to unique populations, resources, and research problems. Section 4.1 evidences many of our collaborations outside HE, including the NHS and local service providers; and Section 1.3.B overviews our approach to interdisciplinary collaboration. Collaborative PGR activity, specifically programmes working with non-academic partners in business and service providers are discussed in Section 2.2.A; and our internal PGR studentships, are allocated on many factors, including cross-institutional collaboration (Section 2.1.B3). At a more operational level, we ensure researchers have the support they need to create and sustain collaborative activity. Support for cross-institutional research collaboration is available through internal funding (Section 1.2), and conference travel and institutional visits for collaboration are fully supported, primarily through our generous overheads policy (Section 2.1.B3). The success of these multiple initiatives is evidenced in our submitted REF2 outputs, 69% produced in collaboration with other institutions.