Institution:
ASTON UNIVERSITY

Unit of Assessment:
3: ALLIED HEALTH PROFESSIONS, DENTISTRY, NURSING AND PHARMACY

a. Overview

The School of Life & Health Sciences (LHS) pursues interdisciplinary research extending from the laboratory to the clinic. Our work ranges from the molecular and cellular, through neural systems and human behaviour, to the restoration of health and the study of individuals in health care and societal settings. Research is presented from four themes **A) Cellular & Molecular Biomedicine**; **B) Chronic & Communicable Conditions**; **C) Clinical & Systems Neuroscience** and **D) Vision, Hearing & Language**, which encompass research from allied health subjects; biomedical sciences, pharmacy, neurophysiology, optometry and health psychology.

b. Research strategy

Strategic aims and changes to the environment 2008-2013

A) Cellular & Molecular Biomedicine draws on RAE 2008 strengths in biomedicine and recent appointee expertise to focus on molecular targets for therapeutics; **B) Chronic & Communicable Conditions** unites the common approaches of former RAE 2008 themes to increase critical mass in mechanistic and interventional research; **C) Clinical & Systems Neuroscience** brings close engagement between patient-focused studies and cellular neurosciences; and **D) Vision, Hearing & Language** explores visual and auditory perception to inform interventions.

LHS leads three interdisciplinary cross-school centres of excellence with the School of Engineering & Applied Sciences (EAS), Aston Business School and the School of Languages & Social Sciences. These Centres span thematic boundaries and include the Aston Research Centre for Healthy Ageing (ARCHA), the Aston Brain Centre (ABC) and the newly formed Centre for Research in Vision & Hearing (CRVH). Each Centre provides infrastructure, equipment and technical resources as outlined in section d.

In line with our strategic aims, we have enhanced our environment since 2008 as evidenced by:

- The recruitment, development and retention of excellent researchers. New strategic research appointments have been made in; 3 Professors, 3 Readers, 5 Senior Lecturers, 6 Lecturers and 4 research fellows. 61 (56.8 FTE) staff are returned in REF2014 compared with (cf) 56.4FTE in 2008.
- Improved research productivity through a challenging and supportive environment. Initiatives include revised promotion criteria and effective training and mentoring to aid progression. Publication record and research income are both target driven, while a School-wide workload model balances research, administrative and teaching duties. Since 2008, LHS staff members have published over 1500 ISI ranked outputs (cf 960 publications in the period 2001 - 2008).
- Doubling our annual research awards from RCUK, EU, Government, charities and industry. This has been facilitated by the effective management of research grant planning and peer review of funding applications, and our increased response to initiatives such as Targeted Priority Studentships (e.g. in ageing, from BBSRC), and EU and RCUK priorities. The value of research awards since 2008 amounts to £23.7M (cf £12.04M in the period 2001 - 2008).
- Enhanced effective collaborative international partnerships. Current projects include Marie Curie ITNs (**Griffin**, **Griffiths, Talcott**), FP7 (**Gibson** – EUROCONDOR, **Perrie** - TRANSVAC and **Griffiths** - MARKAGE) and IAPP (**Griffin** - TRANSCOM).
- Increasing the range and depth of LHS engagement with commercial and health organisations. LHS has received 29 CASE studentship awards since January 2008 including 17 BBSRC awards, 9 EPSRC, 1 ESRC and 2 MRC awards, numerous industry-funded partnership and 7 KTP awards. In 2012-13, 30% of research awards were generated through such projects. The number of postgraduate research (PGR) studentships increased from 72 FTE in 2007 to 137.5 FTE in 2013, 32 of whom are funded on a 4-year programme. In this period we have maintained a completion rate (within 4 years full-time or 7 years part-time) of 88%.
- Infrastructure development. We have invested £9M over the past 5 years to support high quality research environments in the ABC, ARCHA and CRVH.

Thematic activities, operation and achievements 2008-2013

Here we summarise the activities and major achievements of researchers within each thematic area. Seven of these staff were early career researchers (ECRs) in 2008 and ten further staff are returned as ECRs in 2013, illustrating the effectiveness of our support mechanisms for research development and our vibrancy. Research is promoted through core technical support in biomedical services (Biomedical Facility; BMF), cellular imaging (ARCHA imaging suite), synthetic chemistry, chemical analysis and molecular modelling suite (CAMMS) and brain imaging (ABC). L- Lecturer, SL- Senior Lecturer, R- Reader. International collaborators are identified in *italics*.

THEME A. CELLULAR AND MOLECULAR BIOMEDICINE

PROFESSORIAL LEADS: **AHMED, BILL, GRIFFIN, PITT, POYNER.**

CONSTITUENCY: **AHMAD, BAKLAVA (ECR), CHEONG (SL), COLLIGHAN (L), DEVITT (SL), GROSS (L), HINE (R, 0.7FTE), JOHNSON (SL), RATHBONE (SL), ROTHNIE (L, ECR), WASSMER (L, ECR).**

RATIONALE, ACTIVITIES AND OPERATION: This interdisciplinary group combines cell biologists, biomedical scientists, pharmacologists and chemists whose research is promoted through BMF, ARCHA imaging suite and CAMMS with the aims of developing novel protein-based technologies in order to elucidate the role of membrane proteins of relevance for industry; developing new tools to improve the understanding of cell signalling and trafficking; and developing translational methodologies for evaluating efficacy of intervention through clinical collaboration.

MAJOR ACHIEVEMENTS: Identified molecular mechanisms that increase recombinant GPCR and other membrane protein yields leading to the patenting of novel yeast host strains (**Bill** with **Poyner**); developed a platform for the direct detection of multiple transcription factor activities in parallel (**Pitt**); described a mechanism for clathrin cage disassembly by Hsc70 and auxilin (**Rothnie**); identified a molecular interaction partner for the retromer complex that mediates endosome to trans-Golgi network transport (**Wassmer** with *Korswagen, Utrecht and Goud, Paris*); identified the role of VEGF receptor hetero-dimerization in angiogenesis and endothelial biology (**Ahmed** with *Weich of RELIATech, Wolfenbüttel*); identified a novel pathway in the pathogenesis of preeclampsia and a new therapeutic approach for both preeclampsia and fetal growth restriction (**Ahmed, Ahmad** now in clinical trial); established a novel function for tissue transglutaminase (TG) as a key regulator of fibronectin deposition and characterized a collagen scaffold enzymatically cross-linked with a tailored elastin-like polymer for tissue engineering (**Griffin, Collighan** and **Gross**); defined a novel secretory pathway for TG-2 and developed inhibitors (**Griffin, Rathbone**) that block scarring and restore kidney function (**Griffin**); elucidated the paracrine activities of human stem cells that provide rationale for their clinical application in the treatment of bone fractures, spinal cord injury and skin wounds (**Johnson** *with Baba, Fukui*).

THEME B. CHRONIC AND COMMUNICABLE CONDITIONS

PROFESSORIAL LEADS: **BAILEY, GRIFFITHS, LAMBERT (0.2FTE), PATTISON, PERRIE, TISDALE (0.2FTE).**

CONSTITUENCY: **BADHAN (L, ECR), BELLARY (Clinical SL), BROWN (L), FARROW (SL), FLOWER (R), HOLLAND (SL), KNIBB (SL), KIRBY (L, ECR), LOWRY (L, ECR), SPICKETT (R).**

RATIONALE, ACTIVITIES AND OPERATION: This group combines interests of biomedical scientists, pharmaceutical scientists and health psychologists. Utilising facilities within BMF and CAMMS, researchers aim to prevent infectious disease by antimicrobial medicine and vaccines, through formulation and delivery improvements, and to improve understanding of the mechanisms, markers and management of chronic conditions including inflammation, diabetes and obesity.

MAJOR ACHIEVEMENTS: Pioneered the clinical evaluation of copper touch surfaces in the control of hospital acquired infection (**Lambert**); developed a vaccine formulation that facilitates the requirements of sterility, stability and safety (**Kirby, Perrie**); established that cationic liposomes are able to promote a depot effect for both adjuvant and antigen, a key requirement of an effective vaccine (**Perrie** *with Andersen, Copenhagen*); identified small-molecule adjuvants by *in silico* modelling and structure-based drug-design (**Flower**); conducted a systems biology analysis of the molecular fingerprint of acute inflammation and resolution (**Griffiths**); established that zinc-alpha2-glycoprotein has both anti-obesity and anti-diabetic properties (**Tisdale**); conducted a large randomised controlled trial on clinical care of south Asian individuals with type 2 diabetes (**Bellary**); conducted the first large clinical trial on dapagliflozin an inhibitor of sodium-glucose co-

transporter-2, for the treatment of diabetic hyperglycaemia in patients with type 2 diabetes (now clinically approved) (**Bailey** with *Bastien and List, New York*); improved understanding of the psychological factors which underlie successful assessment and management of chronic health conditions (**Holland, Knibb, Pattison**).

THEME C. CLINICAL AND SYSTEMS NEUROSCIENCE

PROFESSORIAL LEADS: **BURGESS, FURLONG, HOLLIDAY, KESSLER, RIPPON, SERI (Clinical), STANFORD, WOODHALL.**

CONSTITUENCY: **ARMSTRONG (L), HASSEL (L, ECR), HILL (ECR), JOGIA (ECR), LONGE (L, 0.6FTE), MAIDMENT (SL, ECR), PARRI (SL).**

RATIONALE, ACTIVITIES AND OPERATION: This theme encompasses a team of experimental psychologists, clinical neurophysiologists and cellular neuropharmacologists (facilitated through BMF) within ARCHA and ABC. It aims to develop non-invasive diagnostic methods, and effective pharmacological and surgical interventions for the treatment of neuro-degenerative, neurological and psychiatric disorders.

MAJOR ACHIEVEMENTS: Reported astrocytic glutamate release induced plasticity indicating a role for astrocytes in brain homeostatic function (**Parri**); established pharmacological evidence for functional CB2 cannabinoid receptors in the CNS (**Woodhall**); characterised the electrical properties, subunit composition and cellular localisation of GABAergic synapses in the globus pallidus (**Stanford** with *Seighart, Vienna*); developed a mathematical 'Firefly' model that explains event-related changes and event-related (de)synchronisation (**Burgess**); characterised the sensitivity and value of the use of MEG for the study of pharmacokinetics and modulation of neuronal network activity by pharmacological and transcranial magnetic stimulation (**Furlong, Stanford** and **Woodhall**); established that functional source separation of EEG/MEG data can provide accurate localisation of structures involved in somatosensory pathway (**Seri** *with Rossini, Rome*); identified pathophysiological biomarkers in unipolar depression and bipolar disorder using fMRI, DTI and MEG (**Hassel** with *MacQueen, Calgary*); demonstrated for the first time the influence of the CACNA1C genotype on neural circuitry and processing, and a mechanism linking bipolar disorder to genetic risk variants (**Jogia**); established a role for executive function in working memory thus providing an explanation of obsessive-compulsive checking (**Kessler**); undertook a landmark study to show link between anti-cholinergic burden, cognitive impairment and mortality (**Maidment**).

THEME D. VISION, HEARING AND LANGUAGE

PROFESSORIAL LEADS: **ANDERSON, GEORGESON (0.2FTE), GIBSON (Clinical, 0.5FTE), GILMARTIN (0.4), MEESE, ROBERTS, TALCOTT, WOLFFSOHN.**

CONSTITUENCY: **DAVIES (R), JUTTNER (SL), LOGAN (L), ROMANI (SL), SHAPIRO (SL), WITTON (R).**

RATIONALE, ACTIVITIES AND OPERATION: Theme D brings together optometrists, psychophysicists and experimental and educational psychologists in order to advance the understanding of human vision, hearing and language in health and disease, and to apply this knowledge in developing improved clinical assessment, diagnostics and interventions.

MAJOR ACHIEVEMENTS: Demonstrated that inhibitory innervation of ciliary muscle is linked to near-work induced myopia (**Gilmartin** *with Ciuffrieda, New York*); showed that posterior chamber shape in myopia constitutes a biomechanical limit on axial elongation (**Gilmartin; Logan**); developed a novel imaging system using multispectral analysis for assessing retinal disease (**Gibson**); developed a novel multi-scale model of visual feature coding to explain the perception of real and illusory contours (**Georgeson** *with Webster, Reno*); showed how neural convergence integrates information across eyes and space to represent higher-order properties that define visual objects (**Meese**); demonstrated, using MEG, that variations in alpha rhythms within occipital cortex are predictive of human visual performance (**Anderson** *with Yamagishi and Kawato, Kyoto*); established that modulation of the frequency contours of speech formants influences the perceptual organization of speech (**Roberts**); demonstrated the important role of auditory and visual timing tasks to dyslexia subtypes and their associated developmental trajectories during reading development (**Talcott**); demonstrated variable developmental trajectories of children's reading and cognitive skills in the context of sensory processing (**Witton**); established the universal principles of phonological/articulatory complexity (**Romani**); provided evidence for shared genetic effects across specific language impairment and dyslexia (**Talcott**).

Research plans 2014-2019; responsiveness to national/international priorities and initiatives

Our future strategic aims will focus on the growth of research centres which are, or have the potential to be, world-leading. Thus, we aim to build on our expertise in metabolic and vascular biology, neuroimaging and drug delivery; extend excellence in cell and molecular biology to clinical trial; and translate fundamental knowledge in vision science to clinical optometric practice.

ARCHA's mission is to increase understanding, predict and intervene to facilitate healthy ageing, with focus on the eye, the mind, and metabolism. ARCHA's approach in ageing research is unique in the UK, with strategies to prevent and mitigate effects of ageing through pharmaceutical and optometric sciences (in collaboration with EAS), which directly align with EPSRC healthcare priorities. We are responding to the strategic plans of MRC, BBSRC, Horizon 2020 and the Wellcome Trust who have stated the importance of understanding ageing across the life-course to improve health and wellbeing. We are addressing an EU challenge to reduce the gap between healthy life expectancy and actual lifespan by 2 years by 2020 through contribution to the European Innovation Partnership (EIP) on Active and Healthy Ageing.

Capitalising on a unique infrastructure and interdisciplinary team ranging from cellular neuro-physiologists, physicists, computational modellers to clinicians, the ABC aims to develop applications of fundamental research and translate these for improved clinical service provision. These priorities align with MRC's goals to train more researchers to take an integrative approach to neuroscience and build research excellence in neurodevelopment, mental health and neurodegeneration, the latter also being a key priority for Horizon 2020.

Aston's Centre for Vision and Hearing Research (CVHR) pursues basic research into the function of the human visual and auditory systems drawing on methodologies from visual psychophysics, computational modelling and neuroimaging in order to understand the fundamental workings of perceptual systems and how data is encoded to build meaningful representations of the outside world upon which we can act. These studies directly address the strategic priorities of EPSRC - human computer interactions and the ESRC - influencing behaviour and informing interventions.

Therefore, we will prioritise our investments in capacity and infrastructure to further strengthen the interdisciplinary research environment in Centres in order to better support our excellent research.

Strategic goals include:

i. Doubling the value of research awards e.g. by building academic capacity in priority areas.
ii. The expansion of our research student cohort funded through industry, health partners, research councils, governments and international partnerships to include professional doctorate students who are conducting applied research apposite to the allied health professions.
iii. Achieving closer engagement with service users e.g. industry and Foundation Trusts through our advisory boards to facilitate timely recognition of strategic research and IP exploitation opportunities.
iv. Enhancing Centre research infrastructure e.g. CRVH and a virtual reality suite facility (see d).
v. Increasing the depth of our international collaborative alliances to serve as additional platforms for developing, promoting and disseminating our research, thus enhancing our citation profile.

To succeed in these goals we will:

- **Grow through capacity building via research fellowship schemes.** In the REF period we have offered capacity-building senior research and principal research fellowships to high calibre investigators joining our centres (e.g. **Ahmad,** theme A, **ARCHA**; **Jogia**, theme C**, ABC**; **Brown,** theme B**, ARCHA**; and **Hill,** theme C, **ARCHA** and **ABC**). This ongoing fellowship scheme offers 100% research time and promises strong outcomes.
- **Enhance our infrastructure.** Following on from a successful equipment bid to The Wellcome Trust for MEG we have developed a matched-funding strategy to support infrastructure bids which will further enhance facilities within our research centres.
- **Develop our NHS partnerships.** We will grow our existing inter-disciplinary relationships; 1) at Heart of England Foundation (HEFT; already enhanced through **Bellary and Gibson**), with a joint translational research laboratory; 2) at Birmingham Children's Hospital (BCH, already enhanced through **Seri and further joint appointment under offer**) through the national epilepsy research centre; and targeting NIHR, industrial and strategic awards. We also plan to offer new clinical awards e.g. Doctor of Medicine and have developed Pharmacy doctorates.
- **Increase industrial partnerships.** Locally, **Griffiths** leads on delivery of high level research

instrumentation (e.g. mass spectrometry) to end user SMEs from the West Midlands through the ERDF project "Promoting Biomarkers in the West Midlands" focused on growth through new partnerships. 50% funded studentships were introduced in 2012 to lever industry support e.g. **Flower** and 50% UCB. We currently have joint industrial funding e.g. with Glaxo, Eli Lilly, Unilever, Johnson and Johnson, Abbott Laboratories and Isogenica and will build on these industrial associations and with global businesses in the future to promote end-user relevance and excellence in partnership.

- **Extend IP and exploit patent portfolio.** We aim to enhance our portfolio through providing funding for focussed patent-specific research that increases its commercial viability. Our current portfolio includes 24 disclosures and 14 patent families incorporating treatments for preeclampsia (**Ahmed**) and treatments relating to TG-2 pathologies (**Griffin**).
- **National and international partnering within academic communities.** We aim to extend external collaborations using platform expertise in pharmaceutics, neuroimaging and analytical mass spectrometry from our current UK portfolio to the international arena. At present, ABC members are a partner in a £1.46M MRC Partnership grant 'Building capacity in UK clinical MEG research' with the Universities of Cardiff, Nottingham and Glasgow. As part of the EPSRC-funded Proxomics consortium, **Pitt** is leading a cross-disciplinary collaboration with groups at Imperial College London and Glasgow on approaches and instrumentation for mass spectrometry, protein microarray production and their analyses. **Perrie** is a partner in the EPSRC Centre for Doctoral Training with UCL in Emergent Macromolecular Therapies.
- **Extend depth of overseas collaboration.** We currently have extensive partnerships in the EU through COST programmes (**Seri, Spickett, Griffiths**) and a number of strategic alliances with a number of institutions through which we aim to enhance our profile internationally, notably: The Neurodis Foundation incorporating INSERM, Lyon and Grenoble Universities; Chinese University (Hong Kong), Macquarie University, QUT (Sydney), Anna University (Chennai) and Ho Chi Min City Biotechnology Centre (Vietnam). **Johnson** (2012) secured funding under the UKIERI Department of Science and Technology Thematic Partnership to develop research with Anna University. In addition, **Perrie** (2013) secured funding under the British Council Researcher Links 2013 to develop research with Ho Chi Min City Biotechnology Centre bringing students to Aston. We plan to extend this to an international doctoral training centre in Biotechnology and Vaccinology.
- **Expand our EU funding.** We will expand our EU and international networks to recruit incoming Marie Curie fellows and increase the number of researchers and principal investigators. We will target Horizon 2020 with our industrial partners enabling us also to focus on excellent research with high potential for industrial impact. We already have significant strength in Marie Curie Initial Training Networks having secured programmes as co-ordinating partner (e.g. **Griffin**) and as participants. Our goal is to promote effective SME- and academic-led programmes with senior staff to seek prestigious ERC fellowships. **Bellary, Brown, Griffiths, Holland** and **Maidment** are members of the EIP on Active and Healthy Ageing. ARCHA is involved in the Europe-wide Knowledge Innovation Community bid, under the banner 'Innolife' with **Griffiths** leading Innovation in the Midlands.

c. People

i) Staffing strategy and staff development

LHS aims to recruit, retain and support high calibre researchers at all stages of their research careers. Our move towards establishing centres of excellence is part of this strategy by providing a focused, world-leading research environment. Centres are guiding future appointments resulting in effective succession planning. Academic appointments are made where there is clear synergy with existing researchers and infrastructure, where the research area has clear applicability to stake-holders and is in line with funders' strategic goals. This enables us to build genuinely collaborative and focused but multidisciplinary groups. In addition to conventional academic appointments and capacity-building senior research and principal research fellowships, we have also recruited clinical scientists in core areas to promote a productive, translational research culture. ECR appointments in the REF period include in theme A, **Rothnie**, **Wassmer** and **Balklava;** in theme B, **Bellary** (clinical appointment), **Lowry, Badhan** and **Kirby**; and in theme C, **Hill, Hassel, Jogia** and **Maidment** while leadership has been enhanced by Professorial appointments; **Ahmed** and **Pitt**, theme A; and **Kessler**, theme C.

Arrangements for developing and supporting staff in their research

LHS aims to encourage and develop research staff through target-driven publications, income and research student numbers, annual performance reviews, performance-related pay and promotion. Aston University promotion criteria were revised in 2011 to incorporate explicit independent pathways recognising research or teaching excellence. This has paved the way for some academics to elect to take on more responsibility in the administrative and teaching arenas allowing prominent researchers more time for successful, creative research. In 2010 we also introduced 'strategic research sabbaticals' to provide at least three months to concentrate on strategically important research projects, technology transfer (e.g. **Hine**) and funding applications.

Staff contributed to development of the action plan to address the Concordat to Support the Career Development of Researchers which was revised in 2009. Aston received the HR Excellence in Research Award in September 2010, recently renewed for a further two years. Aston is one of only ten universities to have held the Award since 2010. Key achievements include: revised recruitment and selection procedures; revised performance review process and performance related pay framework; careers service advice and extension of mentoring and post-doctoral societies, led by LHS and extended across the University. In addition, Aston University was awarded the Athena Swan bronze award in 2011 in recognition of our commitment to the advancement and promotion of the careers of women in Science, Engineering and Technology. LHS achieved a bronze award in 2013. Aston is committed to the development of women as research leaders and is supporting **Witton** on the Aurora programme in 2013/14. Equality and diversity are core to the values of the University and are considered through the committee structures, e.g. at School Management team.

Developing research activities of new staff

The Research Support Office (RSO) is the interface between researchers and the finance and legal teams. The RSO plays a key role in facilitating the development of strong, competitive research proposals and since 2010 has coordinated a peer review system. In addition, ECRs have worked closely with RSO to develop an individual five year research pipeline which is subject to regular review with mentors. Our compulsory mentoring scheme for all lecturers, senior lecturers and ECRs facilitates research independence and thereby continuity of research activity. As part of their career development plan, each researcher completes a Training Needs Analysis and attends courses mapped to the Researcher Development Framework. The first three years of any academic post is accompanied by a reduced teaching load allowing time to initiate research programmes and develop research proposals. The success of these initiatives is evidenced by our current overall funded research application success rate of 26%. Notable achievements from those ECRs in 2008 and returned in 2013 are **Davies** KTP 2011 (£195K); **Shapiro** ESRC 2009 (£606K); **Parri** BBSRC 2012 (£331K); **Woodhall**, NC3Rs 2008 (£152K) and Parkinson's UK 2011 (£177K); and the success of our current ECRs including **Hill** NC3Rs 2011 (£73K); **Lowry** MRC CASE 2012 (£121K); and **Wassmer** and **Balklava** BBSRC 2013 (£438K).

All ECRs entering academia for the first time are assisted by the allocation of start-up funds and in many cases a fully-funded PGR studentship. All new staff attend an induction programme and ECRs participate in a University-wide ECR forum to support interdisciplinary research collaboration. Clinical staff appointments (e.g. **Bellary**) are given greater support for integration into the academic environment from Aston Health Research and Innovation Cluster (AHRIC). AHRIC facilitates networking opportunities for researchers and clinicians to extend their mutual research interests, advising new clinical academics on University governance processes. Further to this, seed-corn funding in order to generate pilot data is available from the annual research budget through an internal bidding process. In addition, central University funds are available to each School annually to allow eminent scientists to visit Aston or for Aston staff to visit international labs for training and to foster collaborative networks (e.g. **Wassmer** visiting Montell, University of California 2013, **Hassel** visiting Cheyne, University of Toronto, 2013). A separate fund is also available to cover publication page and open access charges.

Since 2008 LHS has facilitated the development of grant writing through annual project writing and fellowship writing workshops. The RSO also employs an EU specialist to develop strategies for international partnering and to support the research funding application process via the EU.

ii) Research Students

LHS has 117 full-time and 41 part-time current postgraduate (PG) research students. This includes 1 MPhil and 25 professional doctorate (Doctor of Optometry) students who have transferred to the

research stage of their studies and overseas students (35) who receive School bursaries of £6-10K p.a. towards international fees and £4K p.a. towards bench fees. Home/EU students have been funded through diverse sources such as Research Councils (8%), charities (8%), self-funded (18%), EU (3%), School scholarship schemes (27%) and industrial partnerships e.g. CASE (36%).

Training and supervision

The administrative processes for student recruitment, admission, training support and monitoring are overseen by the Graduate School (GS) and supported by the LHS Research Office. The GS provides the Regulatory Framework for research students, including annual updates of generic information for the Student and Supervisor Handbooks. Research projects are reviewed internally for quality prior to advertisement. Applicants are interviewed by a panel comprising of a minimum of two staff including the prospective supervisor to assess their knowledge base, capability, and motivation for research. In keeping with UK Quality Code for HE (B11, Research degrees), each student appointed has a research excellent supervisory team comprising a main supervisor, an experienced associate supervisor, and the Postgraduate Tutor (**Roberts**, for pastoral support). For academics new to research student supervision, full training is provided by the Centre for Staff & Graduate Development (CSGD). All supervisors receive refresher training every three years. A learning agreement is drawn up within one month of registration to establish the roles and responsibilities of students and supervisor(s), to identify training requirements (training needs analysis), health and safety and ethical considerations.

By the end of the first FTE year, students produce a written Qualifying Report on their research, including a consideration of research ethics and a Health and Safety risk analysis. Each student has a *viva voce* examination chaired by an independent examiner to determine whether they should progress to a Higher Degree. Following discussion, annual reports containing records of at least three supervisory meetings, level of progression and future goals are completed by supervisor(s) and student. In addition, at the end of their second FTE year, students must either: (a) write a report on all or part of their research as a draft journal paper, or (b) present a seminar-style presentation on their research. Structured feedback is provided by the supervisor and an independent assessor.

Personal development

The School is committed to the provision of excellence in PG training opportunities, as defined by a University Code of Practice for research degrees. LHS PGR training provision is now overseen by GS, which was established in 2010 with a mission to ensure a consistent and supportive environment for all research students across the University - one that enriches their experience at Aston and facilitates their development.

The Associate Dean for Research (**Stanford**) has overall responsibility for the academic quality of training and for monitoring student progression within LHS, to ensure that all students develop the skills to become professional researchers. All PhD students are required to complete at least 90 hours of skills training during their degree, unless partial exemption is granted (based on prior qualifications and/or experience). This training includes transferable skills elements in line with UK Quality Code for HE and specific topics such as communication skills, teaching and assessment skills and sciences in a commercial environment. Our professional development programme is accredited by the University and students can choose to undertake a formal assessment to be awarded the Aston Diploma in Transferable Skills. Prior to 2011, our training programme was supported through Roberts funding; it is now supported through direct funding from GS.

Skills acquisition is assessed and monitored in various ways, including the quality of the first year report; the quality of poster and oral presentations at the annual PG Research Day; preparation of manuscripts; evidence of efficiency in research planning; and where relevant, through business plan competitions. Students are actively encouraged to present and publish original data both within and outside the University and funds are available to support presentations at local, national and international meetings.

Student feedback

As part of the Postgraduate Research Experience Survey (PRES), each PG is invited to complete an annual questionnaire to report on research and supervisory facilities. PRES responses are first considered by the School Research & Enterprise Committee, on which PG student representatives sit. At University level, actions arising from PRES feedback are considered by the Graduate School Management Committee (GSMC); LHS PG students are also represented on GSMC. In

addition, LHS has an established PG research student society which supports cross-disciplinary communication, career development and promotes vitality within the research community.

Application of technology generated by research students

Currently, there are 20 CASE studentships active within the School, and a further 9 have completed within the last three years. Examples of commercial applications arising from these awards include; a patent on thermo-stable vaccines (BBSRC/Variation Biotechnologies Ltd); a patent and commercialisation of novel antimicrobial wipes (EPSRC/ Insight Health, **case study 2**); the development of new ophthalmic instrumentation resulting in an iPhone modification to measure eye focus (EPSRC/Abbott Medical Optics), and an evidence-based study demonstrating the efficacy of a lutein-based nutritional supplement for patients with age-related maculopathy (EPSRC/Bausch & Lomb). In addition, CASE students have contributed to two books. One "Recombinant Protein Production in Yeast", is a protocol book in the Methods in Molecular Biology series, and contains chapters on the technological developments. The other, "G-protein Coupled Receptors: Essential Methods" is a protocol book discussing our GPCR-relevant technologies.

d. Income, infrastructure and facilities

Income

Funding to support our strategy for balanced research growth has been obtained from an expanding portfolio of funding sources while income streams have diversified to take advantage of national and international priorities and initiatives. Thus, the value of research awards since 2008 amounts to £23.7M (compared with £12.04M between 2001 and 2008). This funding has been awarded from RCUK (39%), UK government and Health (8%), EU (20%), UK charities (18%) and UK industry (13%) other (2%). **Funding Sources**: BBSRC, EPSRC, MRC, European Union (FP7), ERDF, the Royal Society, British Heart Foundation, Alzheimer's Research UK and pharmaceutical industry, British Academy, ESRC, ITN, IAPP and Marie Curie Fellowships, Diabetes UK, Breast Cancer Campaign, ExtraCare Charitable Trust, NIHR Health Technology Assessment Programme, NIHR Birmingham and Black Country Collaboration for Leadership in Applied Health and Care (CLAHRC) Programme, the Wellcome Trust, Dr Hadwen Trust for Humane Research, the Lord Dowding Fund, NC3Rs, Parkinson's UK, TSB, Waterloo Foundation, College of Optometrists, Vision Research Trust, BUPA, Dunhill Medical Trust, Pocklington Trust.

We have further benefitted through in-kind donations e.g. of optical equipment from small and medium enterprises (SMEs). The academic gains access to cutting edge technology in a fledgling form e.g. Multispectral Retinal Image Analyser and works with the SME (e.g. Topcon) to influence its development and impact, and also retains the equipment.

Infrastructure and Facilities

Aston is a member of the M5 Universities group with Birmingham, Nottingham, Loughborough, Warwick and Leicester Universities incorporating a database of specialised equipment that can be shared between the six leading research-intensive Midlands Universities. Within Aston, research facilities are organised within cross-School Centres of Excellence.

Aston Research Centre for Healthy Ageing (ARCHA) - Director **Holland**

ARCHA is a cross-University initiative launched in September 2010 following a £3M strategic investment in staff and infrastructure. At present ARCHA funds 3 tenure-tracked postdoctoral fellows across the University (including **Brown, Hill** returned here and Martin returned in UoA 15), a technician who oversees the ARCHA imaging suite, 12 PhD studentships (3 studentships via targeted priority studentship funding in ageing from BBSRC, received in 2009) and a Clinical Research Fellow (**Bellary**) in collaboration with the Heart of England Foundation Trust (HEFT). The afore-named staff members have secured funding to appoint 2 additional PhD students (Humane Research Trust; Dudley Group of Hospitals) and 5 postdoctoral research fellows (BBSRC; TSB, ExtraCare). End-user engagement is facilitated by a core-funded administrator and is achieved through hosting (1) the ARCHA panel, a unique group of volunteers over 65 years of age of different ethnicities and typical of the Birmingham population and (2) Birmingham Advisory Council of older adults a forum for engagement with Birmingham City Council.

Specialist equipment includes an advanced imaging facility comprising of a multi-photon confocal microscope, a fluorescence microscope, Seahorse, cell migration analysis and a high performance system for surface plasmon resonance analysis. A proteomics facility includes peptide sequence analysis by LC-MS/MS, a M24 bioreactor and micro-array, a polysome fractionator. Patient

focussed resources include a macular pigment reflectometer, an adaptive optics system, a CANTAB neuropsychological test battery and a research-validated driving simulator. The ARCHA-funded equipment has complemented existing facilities in biomedical, pharmaceutical and optometry research laboratories. Recent grant successes associated with ARCHA include £100K, The Binding Site (**Bellary**); £150K, Dunhill Medical Trust (**Griffiths**); £229K from The ExtraCare Charitable Trust (**Holland**) and £206K FP7, EUROCONDOR (**Gibson**).

The Aston Brain Centre (ABC) - Director **Furlong**

Operational from July 2011, the newly constructed ABC is an integrated research facility for the study of fundamental neurophysiological research for improved clinical provision. To this end, the ABC is registered by the Care Quality Commission for diagnostic service for both paediatric and adult clients and provides a tertiary clinical service for the NHS. In addition, it provides a novel training centre for magnetoencephalography (MEG) and electroencephalographic studies incorporating translational and humane research (see impact **case study 6**).

Funded through £4.4M Aston Strategic Research Infrastructure Funding, the ABC houses the Wellcome Trust laboratory for MEG studies including a paediatric-compliant MEG system. In addition to a 3Tesla MRI, the facility also houses the Development and Dyslexia Assessment Unit offering a facility for both primary and secondary referrals for educational evaluation and the Clinical Neurophysiology Unit, comprising 128 channel dense-array EEG, a trans-cranial magnetic stimulation laboratory and a sound proofed auditory laboratory for clinical testing. Furthermore, there is a dedicated human brain tissue electrophysiology laboratory with extracellular, sharp microelectrode and whole-cell capability (**Woodhall**). Two postdoctoral research fellows provide technical and clinical support to the academic faculty, augmented by recent academic appointments of **Kessler, Hassel** and **Jogia**. The ABC team currently includes 15 funded PhD students. Recent grant success includes; £1M Wellcome Trust (**Furlong *et al*.**); £455K EU, Marie Curie ITN (**Talcott**); £432K Dr Hadwen Trust for Humane Research (**Furlong** and **Witton**).

The Centre for Research in Vision & Hearing (CRVH) - Director **Meese**

CRVH emerged in January 2013 from interdisciplinary research using computer science, psychophysics and experimental psychology in the study of perceptual systems. Laboratory refurbishments in 2012 (£460K) have provided state-of-the-art research facilities. Recent grant success associated with CRVH includes £648K EPSRC (**Meese**), £357K ESRC (**Roberts**).

CVHR is spearheading the development of a new cross-disciplinary £1.3M facility with EAS: The Aston Laboratory for Immersive Virtual Environments (ALIVE) which will combine an immersive virtual reality room and neuroimaging and stimulation technologies (e.g. EEG and TMS) with investigative techniques and protocols from experimental psychology, human computer interaction, and visual and auditory psychophysics. ALIVE will comprise three main facilities: (1) a virtual reality room (Eon iCube), (2) a motion-capture area (Vicon) and (3) a driving simulator. Additional portable components will include: two treadmills, EEG, transcranial magnetic stimulation (TMS) and eye-tracking equipment. The iCube, treadmills and eye tracker will support VR environments for avatars and multiple users to perform experiments on human visual and motor interactions. Linking this to EEG and stimulation (e.g.TMS) will provide unique insights into the relation between human interactions and brain activity.

Facilities for Research Students

LHS research students have access to all core facilities relevant to their research and receive training from appropriately qualified staff. Each student is provided with an office adjacent to their research environment, actual and on-line library access and printing facilities. In our revised space strategy, students occupy a shared space adjacent to their supervisors and our first such reconfiguration is proving highly successful for enhanced academic-student engagement.

Research, Ethics & Governance

The Senate is responsible, with recommendations from University Research Committee and the Graduate School Management Committee, for the assurance of the quality and standards of research undertaken by all staff and students. Maintaining integrity is fundamental to the University's commitment to research. All are expected to adhere to the highest standards of ethical behaviour in conducting research, as well as comply with the letter and spirit of all relevant legislation. Aston has a Research Code of Conduct which prescribes standards of work performance and conduct expected and a Code of Practice for dealing with allegations of Research Misconduct. This may include falsification, fabrication, plagiarism, collusion and other

forms of academic misconduct including inappropriate authorship or lack of authorial recognition. Staff and students have an obligation to report actual or potential infringements of the University's Ethics Framework. Aston's Whistleblowing Policy sets out procedures for reporting concerns and identifies how the institution will investigate allegations.

The University Research Ethics Committee (UREC) and School Research Ethics Committee (REC) are responsible for ensuring that staff and students are aware of ethical issues and for providing appropriate procedures for the consideration and conduct of activities with ethical implications. UREC and School REC are responsible for the ethical scrutiny of research proposals and ensuring that a discussion of potential issues takes place before a project commences. Aston's online ethics review system prompts researchers to provide information about their research which enables the level of risk associated with the project to be assessed. High risk projects are referred to UREC which considers University Sponsorship and insurance.

The University expects all researchers to operate within the spirit and letter of current and relevant legislation: e.g. Data Protection, Freedom of Information, Intellectual Property legislation, Human Tissue Act, NHS Research Governance Framework, Mental Capacity Act, Animals (Scientific Procedures) Act, etc. The Bioethics Committee is responsible for the development, implementation and monitoring of procedures governing the use of animals in research. The University is committed to the principles of the 3Rs (Reduction, Refinement and Replacement) and each project is monitored to ensure that the number of animals used is minimised and that procedures, care routes, and husbandry are refined to maximise welfare.

The University provides training for researchers via the Staff and Graduate Development Team, the Research Support Office, Aston Graduate School and UREC. This includes courses on University Ethics, The Human Tissue Act, and Good Clinical Practice.

e. Collaboration and contribution to the discipline or research base

Notable Honours or Awards

Bailey The Lunar Society Medal, 2013.
Balklava Dorothy Hodgkin Fellowship, 2008-2013**.**
Davies Inaugural Neil Charman Medal for outstanding contribution to research in optometry, optics and vision science, 2010.
Hine BBSRC Commercial Innovator of the Year, 2013.
Perrie Royal Pharmaceutical Society Scientist of the Year, 2012.
Wolffsohn British Contact Lens Association Pioneer's award & lecture 2013.

Evidence of Interdisciplinary Research

LHS prides itself on the extent of interdisciplinary research facilitated through its research centres. Examples of current projects include; the development of novel catheter coatings to prevent MRSA infection in deep vein catheters encompassing medicinal chemistry, biochemistry and microbiology (**Rathbone, Griffin, Collighan, Lambert**); the drive for novel adjuvants for vaccines which involves molecular modelling, biochemistry, drug delivery (**Flower** and **Perrie**); the integration of optometry, medical devices and biomaterials for the study of corneo-scleral shape and crystalline lens (**Wolffsohn** with EAS) and the use of polymer chemistry to extract and stabilise recombinant membrane proteins produced in engineered yeast cells (**Bill** with EAS).

Indicators of Wider influence

Governments departments and regulatory bodies. **Pitt** has a long-standing involvement in advising on the implications of new technologies for the Chemical and Biological Weapons Conventions and recently addressed the United Nation Meeting of Experts in Geneva in 2013. He is currently on the advisory board for the ESRC funded Biochemical Security 2030 project.

Bailey has served as an independent expert reviewer for the FDA by advising on the design of trials and efficacy evaluation leading to metformin's approval (**case study 1**) and now leads on the 'Control to Goal' diabetes treatment guidelines for the Foundation of European Nurses in Diabetes.

Commercial organisations. Since 2008, LHS has received 29 CASE awards from BBSRC, EPSRC, ESRC and MRC, 7 Knowledge Transfer Partnership (KTP) awards, a Bioscience knowledge transfer SPARK award, an ERDF and 3 TSB awards.

NHS. Working closely with BCH and HEFT through joint appointments (e.g. **Seri, Gibson** and **Bellary**) we have established: **1)** a West Midlands research collaboration (3 Universities, 4 NHS and Primary Care Trusts) led by Aston, studying type 2 diabetes in the young; **2)** the Aston/HEFT Ophthalmology Clinical Trials Unit. This jointly funded initiative has delivered an extensive portfolio

of trials and was a key contributor to IVAN (alternative treatments to Inhibit VEGF in Age-related choroidal Neovascularisation), the landmark trial in the treatment of wet age-related macular degeneration estimated to deliver savings of £84.5M p.a.; **3)** the use of MEG to inform pre-surgical screening for refractive epilepsy (**case study 6**). In May 2012, Aston/BCH was awarded centre status for epilepsy surgery (one of two in the UK). **4)** Health Psychology in research and practice at BCH e.g. **Pattison** is a lead researcher in the NIHR Birmingham and Black Country CLAHRC providing evidence for, and evaluation of, redesigned services.

Chairing or Membership of Distinguished Committees

Bailey Co-chair Global Outreach Diabetes education programme; Co-chair DIAMAP- EU7 roadmap for diabetes; Co-chair European Coalition for Diabetes-EU Ministry of Health

Gilmartin Co-opted Chair of College of Optometrist's Research Committee; Member of College of Optometrist's Board of Trustees; RAE 2008 panel member.

Griffin RAE2008 and REF2014 panel member.

Holland Membership of Expert review panel for the Road Safety Observatory, Department of Transport; Invited expert discussant on RAC Foundation 'Maintaining Safe mobility for the ageing population' 2010 and on self-assessment in older drivers 2013.

Perrie Appointed expert on Commission of Human Medicines Expert advisory group (MHRA)

Seri Epilepsy Research UK Committee; Medical Advisor Board, Epilepsy Action; Research Panel of the United Kingdom Child Neurology Research; Panel Member of Health Research Board Republic of Ireland (2011-2012).

Woodhall Member of the UK Government Animals in Science Committee.

Service on International Advisory Boards Relevant to Research

Our staff are currently serving on BBSRC panels (e.g. **Bill, Devitt**, **Griffiths**), ESRC review panels (**Pattison, Shapiro, Talcott**)**,** NIHR Research for Patient Benefit Board (**Pattison**) and also EPSRC college members (e.g. **Hine, Perrie**). Those on international advisory boards include;

Griffiths Panel member MRC Lifelong Health and Well-being 2013; Research Advisory Committee, Research into Ageing, 2008-to date; Chair, Norwegian Research Council, Molecular Biology 2010-2012; Member NIH-BBSRC joint transatlantic ageing programme funding committee 2008.

Poyner Member of IUPHAR nomenclature subcommittee on Calcitonin family receptors.

Membership of Editorial boards

24 of our submitted staff are involved in an editorial role for more than 60 journals.

Keynote research papers or invited addresses at major international conferences

Since 2008, staff have given more than 250 invited /keynote lectures at national and international meetings. Here we list the some of the significant international keynote addresses.

Ahmed 15 keynotes including: International Congress of Preeclampsia, Surabaya, Indonesia 2013; 36th Eastern Canadian Perinatal Investigators Meeting, Toronto 2012; 6th European Meeting for Vascular Biology & Medicine, Paris 2011;Gordon Conference Newport, Maine 2010;16th ISSHIP World Congress, Washington, 2008.

Bailey 34 keynote lectures including: The American Diabetes Association, Philadelphia 2012; American Diabetes Association Congress, Orlando 2010; European Diabetes Association, Stockholm 2010; Abu Dhabi Diabetes Congress, Abu Dhabi 2010; Scandinavian Diabetes Association, Copenhagen 2010; Type 2 Diabetes, Barcelona 2010; European Diabetes Association, Perth, 2009.

Bill 7th Conference on Recombinant Protein Production Laupheim, Germany 2013; New Leaders in Protein and Peptide Science, Beijing, 2011.

Davies Presbyopia, Boston, 2011; American Academy of Optometry, Orlando, 2009.

Gilmartin European Academy of Optometry and Optics, Copenhagen, 2010.

Griffin Gordon Conferences, 2010 Charlotte, USA, and 2012 Davidson College, NC, USA.

Johnson International Spinal Research Trust, London 2013; Tissue Engineering and Regenerative Medicine International Society, Granada 2011.

Poyner 7th International meeting on CGRP, calcitonin, adrenomedullin and amylin, Auckland 2010; International Headache Research Society, Copenhagen 2009; 3rd International Congress on Molecular Medicine, Istanbul, 2009.

Rothnie Australian Society for Biophysics, Sydney 2012.

Spickett International Symposium on Redox Signalling and Oxidative Stress, Valencia 2012;

Proteomics Applications in Health Science, Aveiro, Portugal 2012.

Talcott Australasian Cognitive Neuroscience Society, Macquarie University, Sydney, 2011.

Wolffsohn Asia Cornea and Contact Lens Conference, Hong Kong, 2011; Wavefront and Presbyopia Correction Conference, San Diego, 2011; XIV Annual Interdisciplinary Conference, Bologna, 2010.

Effective Mechanisms to Promote Collaboration

Ahmed Chair and Organiser of the 7th International Congress on Heme-oxygenase, Edinburgh 2012; Chair and scientific committee: Role in Physiological Processes Beyond Heme Degradation at 6th International Conference Heme-Oxygenase, Miami, 2009; Co-chair Predictors of Preeclampsia and Angiogenesis at 16th World Congress International Society for the Study of Hypertension in Pregnancy, Washington DC, 2008.

Bill Chair of the organising committee: 5th Midlands Biophysics Network, Aston, 2012

Griffin Member of organising committee and discussion leader at Gordon conference on Transglutaminase in Human Disease, Davidson College, NC, USA, 2012.

Griffiths Organiser Biochemistry Society symposium Aston 2011& BSRA Aston 2012; Chair and organising committee for 16th Biennial Meeting of Society for Free Radical Research International Imperial College, London 2012.

Hill Meeting Organiser Alzheimer's Research UK, 2012

Johnson Meeting Organiser 7th UK mesenchymal stem cell meeting, Galway, 2013; Meeting Organiser 5th UK mesenchymal stem cell meeting, Aston, 2011.

Poyner Co-organiser, Symposium on family B GPCRs, British Pharmacological Society meeting, 2011 and Biochemical Society Focused meeting on GPCRs, Prato, 2012.

Spickett Organiser European summer school, Mass spectrometry, Aston, 2013.

Effective National & International Collaboration

Evidence of outputs from 12 successful international collaborations are indicated in research achievements for each research theme (section b). LHS staff have more than 50 current international collaborations and more than 70 national collaborations. The table lists examples of funded international and UK collaborative projects with external bodies, industry and NHS.

Individual	External Organisation	Lead Collaborator	Funding agency	£
Flower	UCB Pharma	Shi, Belgium	50/50 studentship	34K
Gibson	Coimbra Ophthalmology Reading Centre	Cunha-Vaz, Portugal	FP7-EUROCONDOR	206K
Griffin	University of Debrecen	Fesus, Hungary	IAPP-TRANSCOM	457K
Griffin	University of Rome	Piacentini, Italy	FP7-TRANSPATH	693K
Griffiths	University of Konstanz	Burkle, Germany	FP7- MARKAGE	313K
Gross	Forschungszentrum, Julich	Hoffmann, Germany	50/50 studentship	34K
Lambert	Wyeth Pharmaceuticals	Longshaw, USA	Wyeth	30K
Perrie	Variation Biotech. Inc. Ontario	Anderson, Canada	BBSRC (CASE)	90K
Perrie	Staten Serum Institute	Andersen, Denmark	FP7 -TBVAC	99K
Talcott	NTNU Trondheim	Vulchanova, Norway	FP7 - LanPercept	455K
Tisdale	Halsa Pharm. plc, Texas	Speros, USA	Halsa Pharm.	339K
Wolffsohn	Lenstec, Florida	Clough, USA	Lenstec	75K
Bellary	HEFT	Barnett, UK	The Binding Site	100K
Bill	GSK	Dowell, UK	BBSRC (CASE)	124K
Griffiths	Unilever UK	Talbot, UK	BBSRC (CASE)	147K
Holland	Heart of Birmingham PCT	Rutledge, UK	HoB PCT	74K
Lambert	Mologic Ltd	Davis , UK	TSB	104K
Lowry	Morvus Technology Ltd	Knox, UK	MRC (CASE)	99K
Pattison	B'ham & Black Country Collab.	Lilford, UK	NIHR	30K
Stanford	Eli Lilly	O'Neil, UK	BBSRC(CASE)	121K
Wolffsohn	VisionCare Research Ltd	Young, UK	KTP	195K
Woodhall	BCH	Walsh, UK	50/50 studentship	34K