Institution: University of Leeds

Unit of Assessment: 4 (Psychology and Neuroscience)

a. Overview: We strive for research excellence in *Psychology* and *Neuroscience* (our Psychiatry research is returned via UoA2). The UoA4 group in the Faculty of Medicine and Health (FMH) includes researchers from the Institute of Psychological Sciences (IPS), Leeds Institute of Health Sciences, Leeds Institute for Biomedical and Clinical Sciences, and Leeds Institute for Genetics, Health and Therapeutics; while the Faculty of Biological Sciences (FBS) neuroscientists are based in the School of Biomedical Sciences. In RAE2008, the UoA was organised into four groups: Biological Psychology; Cognitive Psychology; Health & Social Psychology; Biological Sciences. These groups worked well at an organisational level, but to deliver our goals of enhanced multi/interdisciplinary collaboration and research excellence with economic and societal impact in 2011 we aligned our expertise with external need and identified five Research Grand Challenges, around which we now coordinate our research activities (see **section b**: Research strategy).

Researchers in UoA4 collaborate extensively within and across other Faculties (e.g. Engineering, Mathematics, Physical Sciences) and across the NHS to address these grand challenges (e.g. Case Study 4). The UoA4 neuroscience initiative NeuR@L (www.neural.leeds.ac.uk) draws together academics from FMH and FBS and provides a forum for collaboration between Psychology and Neuroscience (see below for collaborative output). UoA4 participates in large cross-Faculty initiatives such as the Biomedical and Health Research Centre (BHRC) with £13.5m University funding (benefitting UoA4 through support of translational research, e.g. Postdoctoral Translational Fellowships). We enjoy collaborative relationships with external organisations, e.g. Bradford Institute for Health Research (BIHR). BIHR is a unique research partnership between NHS Trusts in Bradford and Airedale (serving 549,000 residents) and the University of Leeds (UoL). There is passion and commitment from BIHR to harness the expertise within psychology and neuroscience at UoL and establish the partnership as a national leader in applied research. BIHR fund three academic positions in UoA4 (**R.Lawton**, **Johnson, Kellar**) and a PhD studentship each year as part of our strategic partnership. The Yorkshire Regional Genetics Service (YRGS) is another key partner keeping Next Generation Sequencing (NGS) technologies at the international forefront. The partnership consists of a UoL-based Neurogenetics research grouping which equipped the NGS facility and the Leeds Teaching Hospitals NHS Trust-based YRGS which manages it. These partnerships facilitate close working relationships at the interface between NHS clinical need and UoL research, ensuring ready access to patient material, information, clinical expertise and an integrated approach to translational research.

b. Research strategy: During the REF period we mapped external needs against our internal capabilities and developed an impact-focused research strategy with five Grand Challenges (GCs). Our GCs provide a flexible research framework (all UoA4 staff map on to one or more GC) and encourage working across disciplines to address major research questions. Focus and leadership is provided by GC leaders (inter-faculty) who meet on a monthly basis to agree strategic priorities. The 5 GCs each have a professorial (**Blundell**, **Inglehearn**, **Mon-Williams**, **Bunce & R.Lawton**) and non-professorial lead (**Finlayson**, **Lloyd**, **Waterman**, **Allen** & **Kellar**) who form a mentoring system designed to ensure that staff members at all levels are impact minded. Each GC group comprises academics, non-academics (e.g. representatives from our strategic partners; expert patients; community groups) and students.

Strategic responsiveness to national/international priorities: We respond to national and international priorities by aligning our GCs with funders' strategic priorities (e.g. Horizon 2020, Health, demography and well-being; ESRC 2011-2015, Influencing Behaviour and Informing Interventions; BBSRC 2010-15, Healthy and safe food; ageing research, lifelong health & well-being; MRC 2009-2014, Living a long and healthy life; EPSRC, Healthcare technologies). Our research portfolio has direct relevance to national and EU priorities (e.g. The Dementia Challenge; MRC; Alzheimer's Research UK; EU Platform for Action on Diet, Physical Activity and Health; European Commission's Joint Programming Initiative on Food, Nutrition and Health; see **section e** for mechanisms and examples). UoA4 research is brought together in a coherent framework through the NeuR@L network via its website and annual research meeting for researchers active in neuroscience within and outside the university. Our Grand Challenges have four strategic aims:

Strategic aim 1: Creating critical mass to tackle societal needs. The GCs reflect psychology and

neuroscience related expertise at the UoL and the societal challenges to which we contribute, thus providing a vehicle for enhancing future research impact (see Case Studies). For example, GC3 supported the development of an older adult participant panel to facilitate research, improve knowledge transfer and stakeholder engagement, and generate seminars on ageing from national and international speakers.

Strategic aim 2: Developing high-quality interdisciplinary teams. The GCs bring academics and clinicians together to address major research questions and thereby develop research that achieves significant impact (e.g. Case Study 5). For example, one trainee ophthalmologist and two trainee surgeons have undertaken an MD and two more are studying for PhDs in GC2, strengthening ties between University and NHS researchers.

Strategic aim 3: Enhancing academic excellence. We aim to increase publications in world-leading journals through interdisciplinary working and significant research funding. The GCs provide a means to clearly describe our research to prospective researchers (assisting recruitment) and current postgraduate students and contracted researchers (facilitating research-led teaching and partnership working).

Strategic aim 4: Increasing impact. The GCs play an important role in facilitating our communication and encouraging work with stakeholder communities and groups as well as industry and health services. Specifically, stakeholders help us build links with non-academic groups, recognise their needs, design research in close partnership, facilitate recruitment of participants, disseminate the results of our research and so maximise impact. Strategic aim 4 is underpinned by four mechanisms:

Mechanisms for development, promotion and dissemination of research:

(1) We actively engage with industry/health sectors using a coordinated strategic approach (see **REF3a**) and enjoy UoA level strategic partnerships (e.g. BIHR, Leeds City Council, Leeds NHS Trust). We provide lectures at important events for industry (e.g. Vitafoods, Geneva) and work closely with our Enterprise Office to develop Knowledge Transfer Partnerships (KTPs) and produce non-academic publications to increase the impact of our work.

(2) We engage with policy-makers (as outlined in **section e**), such as Age UK (i.e. holding an Age UK promoted research open day for older adults).

(3) We connect with local community and national groups identified in a pro-active, strategic and co-ordinated approach by GC leads (e.g. Wakefield Council in denormalising tobacco; meetings with the Bradford Asian community on consanguinity and recessively inherited diseases). We run the annual 'Discovery Zone' where approximately 500 Key Stage 2 & 3 pupils try hands-on science in a whistle-stop session of science exploration. We hold research open days targeted at local and national organisations where stakeholders can participate in experiments. We support public engagement initiatives, including Royal Society talks and Cafe Scientifique, and through national theatre (e.g. **McKeown**, science consultant, nationally touring Unlimited Theatre 2013).

(4) We raise awareness through seminars, blogs, twitter and other social media to disseminate our findings. We organise science festivals (e.g. **Mon-Williams** & **Deuchars**, Ilkley Science Festival 2010), and regular research talks (e.g. Physiological Society sponsored open lecture series 2013) and we work with the Schools Partnerships Trust promoting psychology and neuroscience to school students.

GC1 Health and Wellbeing: This GC seeks to maintain the good health and psychological wellbeing of individuals, families and workforces as a cornerstone of future social and economic sustainability. Public Health England identified an urgent need for insights and initiatives to tackle current trends in nutrition and physical activity that have a detrimental impact on health and wellbeing. Our response to the challenge builds upon the 'particular distinction in psychobiology' noted by the RAE2008 panel and incorporates our primary expertise in psychology and neuroscience. GC1 facilitates world leading research with collaborations from diverse disciplines including food science; behavioural genetics; dietetics; exercise physiology; epidemiology and medicine (e.g. **Hetherington** #1). Our approach encompasses preclinical research in behavioural pharmacology (e.g. **Rodgers** #3); human clinical trials (e.g. **Bewick** #4); behavioural research on energy-balance (e.g. **Caudwell** #1); large-scale community and work-based lifestyle interventions

(e.g. **R.Lawton** #2); qualitative methods (e.g. **Madill** #1); and nutraceutical research for cognition, appetite and wellbeing (e.g. **Blundell** #1).

GC2 The nervous system and its disorders: This GC aims to increase understanding of the many different factors that underpin healthy brain function as well as neurological disorders. The WHO predicts that disorders of the nervous system will increase dramatically over the next 30 years and neuroscience has been identified as a priority area by the government's Foresight Panel on Health and Life Sciences. GC2 addresses neural disease with the NeuR@L grouping facilitating cross-faculty and interdisciplinary collaborations. Our research spans cellular models of neuronal disease and basic laboratory studies of animals through clinical and translational genetics research within local NHS services, through to human behavioural and clinical trials, with specific expertise in ophthalmology (e.g. **Inglehearn** #1), consanguinity (e.g. **Bond** #1), preclinical work on drug addiction (e.g. **Rodgers** #4), behavioural neurophysiology of the hippocampus (e.g. **Rodgers** #1), pain at the molecular, animal (e.g. **Gamper** #1), and human level (e.g. **Lloyd** #4; **Morley** #2), sensory neurons (e.g. **Gamper** #2), neuronal excitability (e.g. **Deuchars** #3; **Peers** #1), resulting disorders (e.g. **Clapcote** #2) and intersensory processes (e.g. **Wilkie** #1). GC2's work is sustained by an EU FP7 Training Network (**Inglehearn**, £3m to network, £1m to UK).

GC3 Successful Ageing: This GC focuses on exploring the psychological, social, neurological, and biological processes determining healthy ageing, age associated impairments, and develops tools to beneficially impact the lives of older adults and their families. In response to the cognitive and motor challenges posed by an ageing population, we use our expertise to: (a) increase understanding of the psychological, neurological, and biological processes involved in healthy and unhealthy ageing; (b) identify and develop methods and tools with the potential to have beneficial impacts on the lives of older adults and their families. We explore how healthy ageing affects fundamental and applied cognition, characterizing age-related decline, facilitating detection of age-associated cognitive impairment and dementia (see also GC2) and developing assistive programmes and technologies. GC3 has expertise in areas such as motor ability and driving in healthy older adults and those recovering from stroke (**Raw** #1), plus the early detection of age-related cognitive decline and neurodegenerative diseases (**Bunce** #3). Researchers also examine depression, anxiety, and cognition in older adults (**Bunce** #1), language processes (**Klepousniotou** #2) and age-related changes in quality of life, cognition (**McKeown** #1) and sexual function (**O'Connor** #3).

GC4 Successful Childhood Development: In line with the government policy on 'Raising the achievement of disadvantaged children' this GC reflects the need for all children and young people to lead healthy, fulfilling lives and achieve their full potential. Our multidisciplinary team tackles critical issues affecting successful development including: healthy eating (**Hetherington** #4), the importance of breakfast for successful cognitive performance at school (**Dye** #3); healthy lifestyle, including understanding the factors related to smoking initiation in adolescence (**Conner** #1); understanding how neurodevelopmental disorders affect outcome (**Mon-Williams** #2), and investigating links between consanguinity and autosomal recessive neurological disease (**McKibbin** #1). Researchers within GC4 enjoy strong collaborative ties with the BIHR, in particular the 'Born in Bradford' (BiB) study and Leeds City Council Children's Services.

GC5 Behaviour change: This GC seeks to help people make lasting lifestyle changes to improve the health and quality of life for themselves and others. Creating long-lasting behaviour change is a key component of government initiatives (e.g. improving health through changing individual behaviours). GC5 contributes to a better theoretical understanding of behaviour change techniques by utilising taxonomies in changing proven determinants of behaviour change (**Prestwich** #1). GC5 focuses on changing behaviours related to smoking (**Conner** #1), e-interventions for substance abuse (**Bewick** #3); physical activity (**R.Lawton** #2), blood donation (**Conner** #3 & #4), screening attendance (**Conner** #2; **Kellar** #1) and vaccination (**Conner** #2) and researchers are known for their contributions to multi-level modelling techniques (**O'Connor** #1).

c. People: Our staffing strategy and staff development is centred on the GCs. UoA4 has a philosophy of 'early career development' with Professorial support. Thus, our strategy is to recruit early career researchers with outstanding potential and provide them with mentorship and a research environment in which they can thrive and become the research leaders of tomorrow within the context of the GCs. **Mon-Williams** and **Hetherington** were recruited in 2009 (at

professorial level) and have spearheaded the GC strategy, adding critical mass in GC1&4. We have made recent strategic appointments at Professorial (e.g. **Bunce**, GC3) and lecturer level (e.g. **Clapcote** GC2; **Weighall** & **Nash** GC4; **Lloyd**, GC2; **Kellar** & **Johnson** GC1&5; **Billington** GC2&4) to build capacity across all GCs. All contributing academic units use workload models to protect time for research and develop research impact (40% of time ring fenced for research, 20% protected for scholarship and citizenship). Our staffing strategy is reflected in each of the GCs:

GC1 Health and Wellbeing works with major global industries in the food/ingredient and pharmaceutical sectors creating 2 PhD studentships (**Hetherington** & **Finlayson** e.g. Coca-Cola; Danone) and supporting collaborative research (**Hetherington** e.g. Heinz; **Dye** e.g. Kellogg's, Welch's; **Finlayson** & **Blundell** e.g. Ajinomoto, Novo Nordisk). Involvement in large EUFP7 consortia (**Finlayson**, **Blundell** & **Hetherington**) creates career development opportunities for PhD (e.g. Alison Douglas Summer School) and postdoctoral researchers (e.g. **Caudwell** awarded the Young Researcher of the year award, ECO 2013).

GC2 The Nervous system and its Disorders encourages collaboration with central animal research facilities enabling links across psychology and neuroscience (e.g. MRC funds to **Clapcote** & **Rodgers**). Our environment offers a distinctive opportunity to understand the link between genotype and behaviour and links to GC4 (e.g. congenital deafness and language acquisition, Case Study 5). Throughout the REF period, GC2 invested heavily in PhD students and postdoctoral fellows and developed careers (e.g. **Dachtler**, funded by Wellcome Trust ISSF award, mentored by **Inglehearn**).

GC3 Successful Ageing has strategically appointed leaders in the field (e.g. **Bunce**), and helps develop careers focused on ageing (e.g. MRC Centenary Fellowship to **Raw** on stroke, PDRF and PhD student internally funded for 36 months to **Bunce**). The GC ensures that UoA4 researchers work on multidisciplinary projects across the University (e.g. 50 active years after 50 in the WELMEC Centre of Excellence in Medical Engineering; the Health Care of Elderly group in Leeds Institute of Health Sciences) and with external organizations (e.g. the UK Dementia & Neurodegenerative Diseases Research Network).

GC4 Successful Childhood Development assists early career researchers to obtain funding on developmental topics to continue their career post-PhD, (e.g. MRC Centenary Fellowship to **L.Hill** and EPSRC 'Bridging the gap' grant to **Mushtaq**). GC4 staff benefit from strategic partnerships with key organisations such as Leeds City Council Children's Services, enabling research in schools throughout West Yorkshire (e.g. Case Study 3) and the BIHR (especially the BiB cohort study) providing access to an extensive database of over 13, 500 children and families in Bradford.

GC5 Behaviour Change researchers benefit from excellent links with local NHS trusts to implement and evaluate behaviour change techniques (e.g. changing behaviours related to smoking, **Conner** #1). Our research forms the basis for conduct of Serious Untoward Incident analyses in Bradford Teaching Hospitals Foundation Trust (**R.Lawton** & **Kellar**), and BIHR has funded five PhD students within the last five years in this area.

Integration of clinical/NHS staff: BIHR fund four academic positions within the UoA (e.g. **R.Lawton** within psychology) allowing integration of clinical and academic staff. The BiB study involves both academics and clinicians with joint funded PhDs (e.g. Giles, Shire) and academic positions (**Kellar** & **Johnson**). One major focus is ophthalmology, where advances in sequencing technology have been exploited to assign function to proteins and define novel disease entities (e.g. **Inglehearn** #2). The ophthalmic research lead for the West Yorkshire CLRN and for LTHT (**McKibbin**) is an honorary UoL Associate Professor and is included in this submission as category C staff. UoL researchers collaborate closely with many other NHS staff from the Eye Department and Yorkshire Regional Genetics Service. Our D.Clin.Psych programme (46 doctorates awarded in the REF period) further enhances NHS-University links (e.g. see Case Study 4 and outputs).

Equality and diversity: The UoL is committed to delivering a supportive and professional working environment for our staff. Equality and diversity are core principles within UoA4 and this commitment is embedded across all Faculties, each of which has representation on the University's Equality and Diversity Committee. The University strongly supports the development of women's careers in STEM disciplines, which has been recognised by the renewal of its Athena SWAN Bronze Award in 2012. UoA4 supports flexible working, mentoring and support for staff

returning from maternity leave. Workload models ensure fair allocation of work and take account of part-time staff and those with special needs. The University has established staff networks for disabled and ethnic minority staff and these are widely publicised with staff encouraged to participate. We work closely with the University's student disability support and assessment unit to ensure that research students benefit from appropriate adjustments to support their study. For example, a student with severe (grade IV) cerebral palsy graduated with a Psychology PhD in 2011. The UoL curriculum has a core thread of "Global and Cultural Insights" aimed at ensuring an inclusive experience so that all of our students are enabled to achieve their potential, progress in their studies and move into an academic career if they have the ability and inclination. Psychology was awarded a 'Partnership award' in 2012 by Leeds University Union in recognition of the impact focused research based learning work conducted by staff in partnership with students.

Supporting Development of Researchers: UoA4 has a number of systems to support the training and development of researchers. The University provides a *Next Generation Researcher* programme developed in line with the Concordat to Support the Career Development of Researchers and the national Researcher Development Framework. We have a 'Professorial Academic Leader' scheme where non-professorial staff are mentored by a member of the professoriate and provided with guidance on achieving research excellence and increasing impact. Professorial staff attend University organised leadership courses and staff have funds for research investment. The Staff Review and Development Scheme helps staff achieve their full potential by providing a two-way review of work progress at least once a year. This includes identifying key objectives, providing constructive feedback, recognising success, providing support for improvement, and identifying and planning appropriate development, as well as allowing discussion of career aspirations and aligning these with the strategic research goals of the UoA.

Research Governance. The UoL provides central support to ensure and assure the principles of academic excellence, community, integrity, inclusiveness and professionalism in compliance with the University's policy on ethics, the NHS framework for ethical research and the legislative requirements of the Human Tissue Act. The UoL promotes a values based ethical review process where the ethical review process itself is considered to be a worthwhile activity with supporting University policies (e.g. policies on Data Protection, Whistle-blowing, Research Misconduct).

Postgraduate Research Students (PGRs) in our UoA have desk space in high quality offices and share common rooms with staff, promoting interaction and knowledge exchange. A total of 135 FTEs completed doctoral degrees in the current REF period (increasing in the last year by 36%). UoA4 staff also contribute to supervision of PGRs in other Universities (17 externally supervised PhD students). Some of our PGR highlights are listed below:

• Leeds is within a White Rose University Consortium with the Universities of York and Sheffield and leads an ESRC Doctoral Training Centre and a BBSRC Doctoral Training Partnership in 'Mechanistic Biology'. These consortia awarded 20 studentships per annum for the period 2012-2014 (joint 3rd nationally) to the best students in UoA4. We provide formal research training within the White Rose Consortium, extending their peer network. All PGRs have access to public engagement, influence, innovation and impact training offered by the UoL.

• We adopt a team supervision approach where PGRs draw on diverse expertise including Mechanical Engineering (Flatters), Dentistry (Abdullah), BIHR (Jayewardene, Santillo, Louch, Ozer, Shires); industry partners, including Schools Partnership Trust (Adolphus), Bradford NHS (Rossiter), ARLA Foods (Boyle) and Danone (Norris). PGR representatives (Marshall, Sykes, Santillo) organised the 2012 and 2013 Psychology PGR Conferences attended by York and Sheffield students with Leeds alumni providing keynote talks on 'Life after the PhD' (2012, Gomersall; 2013, Lamport, Rathbone).

• Students present at faculty conferences and participate in the annual UoL PGR conference (Adolphus winning a 2012 poster prize). Our students present at national and international conferences funded by an annual training budget.

• PGRs have been recognised (**Caudwell** - Young Researcher of the year ECO 2013); won prizes at prestigious conferences (BPS - Gray, Marshall, Morson; BBSRC – Dalton, Gibbons; Canadian Obesity Network – Buckland; ECO – Hopkins, Gibbons; Vision Sciences Society - Giles); given invited lectures to industry (Gibbons – Unilever, Danone; Dalton – Nestle); secured competitive

Travel Bursaries (EPS – Dalton, Morson, **Mushtaq**; Leeds for Life – Dalton; Brain - Rossiter); been invited as contributors (Marshall - 2013 BPS Psychology4Graduates Event) and undertaken funded internships (Adolphus - British Heart Foundation [BHF] with ESRC funds).

• Students successfully publish their work in high-quality journals (e.g. Adolphus, Flatters, Pini, Douchamps, Kolokotroni, Gibbons, **Caudwell**, Hopkins, Khan, Parry, Tallet, Wells, Wright) and were co-authors on approximately 25% of the outputs we returned for REF.

• PGRs secure competitive funding to undertake research internships at international research facilities (e.g. Boyle, Surriya, World University Network award; Jersakova, Eiffel Excellence Scholarship), develop research skills (Gibbons - Uppsala) and work on specific research projects (Flatters, EPSRC award).

• PGRs engage in outreach providing taster sessions, mentoring and master classes to A-level students (Koufopoulos, Morson, Marshall, Portch, Wheway) and Research Open Days for the Schools Partnership Trust.

d. Income: Our strategy is to attract a balanced portfolio of research income that allows us to pursue innovative and impactful research within our GCs. The total value of research awards for the UoA was £55.3m with a total expenditure on these grants of £12.7m across the REF period (over twice the RAE2008 value). Research expenditure was approximately 33% from OST Research Councils (e.g. BBSRC, ESRC, MRC), 28% from charities (e.g. Wellcome, British Heart Foundation), 19% from government bodies (e.g. NIHR), 12% from UK industry (Pfizer, MedImmune, Eli-Lilly, Unilever, Kellogg's), 7% EU and 6% from other sources (mainly non-UK industry). Year on year there is some variability in the sources of funding although the total per year is consistent at approximately £2.5m. This partly disguises an increasing amount of research funds going through our collaborators (e.g. BIHR). We benefit from extensive support in generating and maintaining all funding applications, extending from a new UoL system (Kristal) for appropriately costing our grants to ensure sustainability of our environment through to dedicated staff in each Institute, Faculty, and a central University Research and Innovation Service who assist at all stages of obtaining and maintaining a grant, providing a 'cradle to grave' service.

GC1: Health and Wellbeing research is strategically organised to maximise relevance to national and EU priorities in health and science and meet the key objectives of the BBSRC, EU Platform for Action on Diet, Physical Activity and Health, and the Strategic Research Agenda for the European Commission's Joint Programming Initiative on Food, Nutrition and Health. GC1 has obtained UK research council grant funding (e.g. BBSRC: **Finlayson**, £190k, **Finlayson** & **Blundell**, £675k) and has received support from European consortia under successive EU Sixth and Seventh Framework Programmes (EU FP6: **Blundell** & **C.Lawton**, £360k; EU FP7: **Finlayson** & **Blundell**, £439k and £469k, **Hetherington**, £427k and £432k, **Caudwell**, **Finlayson** & **Blundell**, £401k). GC1 creates international reach through partnerships within the US via large-scale NIH research projects (e.g. **Finlayson,** $1.1m; **Blundell** & **Finlayson,** $2.7m).

GC2: The Nervous System and its Disorders ensures its goals are met through sustained grant funding (e.g. MRC: **Gamper** & **Wood,** £647k**, Peers** & **Gamper**, £650k, **Inglehearn**, £474k, **Clapcote** & **Rodgers,** £268k, **Wood**, £834k; The Alzheimer' Society: **Peers** £155k; BHF: **Deuchars**, £196k, **Wood,** £94k, **Peers** & **Scragg**, £600k; The Wellcome Trust: **Deuchars**, **Gamper** & **Inglehearn**, £450k; BBSRC: **Deuchars**, £363k; Sir Jules Thorn Award for Biomedical Research, **Inglehearn**, £1.21m; International Spinal Research Trust: **Deuchars**, £100k; EU, **Inglehearn**, £925k) and major fellowship funding awarded by the Wellcome Trust (**Bond,** £524k, Khan, £223k, both sponsored/mentored by **Inglehearn**) and ARUK (**Peers**, £244k). **McKibbin** is local PI for five clinical trials (£200k) with Novartis (x3), Bayer and Quark Pharmaceuticals. MRC funding for psychiatric genetics (**Clapcote** & **Inglehearn**, £410k) is complemented by studies of behaviour in mouse models of neuronal disease (e.g. **Clapcote** #1, **Dachtler** #1). **Clapcote** has generated and studied mouse models for schizophrenia and received £60k thus far in BioPharma royalties worldwide (licensed to Bristol-Myers Squibb, Sanofi-Aventis, Wyeth).

GC3: Successful Ageing aligns with the key objectives and strategic aims of MRC, ESRC, BBSRC, and the European Commission. Key on-going research has examined nutritional screening, support, and treatment for older adults (Danone: **Hetherington**, £45k), regulation of hunger and satiety across the lifespan (EU FP7: **Finlayson** & **Blundell**, £439k), attentional control and working memory in older adults (ESRC: **Allen**, £98k). UoA4 researchers have also been

involved in projects on physical activity in care homes (NIHR: **R.Lawton**, £2m), and suicidal ideation and behaviour (US Department of Defence**: O'Connor**, £1.9m). The relevance of the GC3 work to the health sector is reflected in NIHR funding (**Mon-Williams**, £110k) supporting the development of therapeutic intervention post-stroke and MRC funds to investigate the efficacy of electrical brain stimulation techniques (**Wilkie** & **Burke**, £81k with MagStim supplying TMS and tDCS equipment).

GC4: Successful Childhood Development attracts national and international funding to address key issues affecting successful development in childhood and adolescence. Major grants have been awarded for research on healthy eating and appetite: understanding the factors and critical periods in food habit formation (EU FP7, **Hetherington**, €427k), exploring how to increase liking for and intake of vegetables in infants (IAPP FP7, **Hetherington**, €430k). Key research on cognitive psychology is also supported, for example, the effect of sleep on novel word integration (Leverhulme Trust, **Weighall**, £160k). GC4 receives international support through consultancy arrangements with the NIH (**Mon-Williams** consultant on NIH grants, $450k and $800k). GC4 work is attractive to health funders; we are part of a CLAHRC2 (£10.0m) consortium (**R.Lawton**, **Conner**, **Kellar**, **Billington**, **Mon-Williams** & **Waterman**), and were supported by the Department of Health (NEAT, **Mon-Williams**, £449k) to work on robotic training for children with cerebral palsy.

GC5: Behaviour Change maps to the key research objectives of the Health Foundation, NIHR Public Health Research, NIHR Health Services & Delivery Research, ESRC and MRC. GC5 systematically reviews interventions that can lead to behaviour change, and this approach is attractive to funders (e.g. KTP plus Leeds NHS Grants: **Prestwich**, **Conner**, **R.Lawton**, **Gardner** & **Kellar**, £55k & £188k; BUPA Foundation: **R.Lawton**, **Conner**, £330k; ESRC: **Conner**, **Prestwich**, **R.Lawton**, £205k, **Conner**, £295k; Unilever: **Conner**, **Prestwich**, **R.Lawton**, **O'Connor**, £355k; NPRI: **Conner**, **R.Lawton**, £1.30m). Our work examines the efficacy of eHealth interventions (NPRI smartphone grant**: Conner**, £313k; Fulbright student supervised by **Conner**, **Gardner** & **Kellar**, £23k), develops and evaluates patient safety interventions (SHA Grant: **R.Lawton**, £360k; Health Foundation Studentships: **R.Lawton**, £250k; ESRC CASE: **O'Connor**, **R.Lawton**, £55k; ESRC Advanced Research Methods Studentship: **O'Connor** & **R.Lawton**, £80k; behaviour change consultants on NIHR project: **Conner**, **R.Lawton**, £1.5m) and attempts to identity vulnerability factors such as personality, eating styles and cortisol profiles (ESRC: **O'Connor**, **Conner** & **R.Lawton**, £114k). Collaboration with GC1 opens up additional funding streams on topics such as behaviour change to promote healthier food intake and diets (NIHR: **Conner**, £350k; NPRI: **Conner**, £566k; consultant on EU NeuroFAST grant**: O'Connor**, €924k).

Infrastructure & **Facilities:** Our position in a large research-active University affords a variety of facilities that are provided by UoL together with the Leeds Teaching Hospitals NHS Trust to support cutting-edge research and multidisciplinary collaboration. This partnership leads to diagnostic test development and NHS service testing and delivers improved genetic diagnosis and healthcare to patients. During the REF period, the University has invested heavily (>£6m) in new and superior animal research facilities that support the Grand Challenges (especially GC2). We have developed patient and participant pools to support research in all GCs. We have excellent central library facilities with extensive psychology and neuroscience holdings including access to electronic journals and database systems (e.g. Web of Knowledge, PsycINFO). IT services provide a site licence for professional software such as MS office, SPSS and there are institute-wide licences for LabView, Matlab and E-prime. Our LabVIEW Academy is the first of its kind in the UK and combines face-to-face teaching with hands on lab exercises using National Instruments programming language. Research is primarily carried out within purpose-built accommodation and in the REF period this infrastructure has benefited from considerable investment (>£1.5m in Psychology; >£2.0m in FBS) to ensure facilities continue to be of the highest quality. In 2008, the UoL and the LTHT invested £10.0m and £3.5m respectively in a joint initiative, the BHRC, to support multidisciplinary translational research to enable effective collaborations across the University and the NHS. Capacity building in translational research was further supported via the BHRC through the creation of an innovative Senior Translational Research Fellowship Scheme (e.g. Bioinformatics Technology Group; Culmer working with **Mon-Williams** since 2011 in the area of surgical technologies).

The Table overleaf highlights some of the facilities enjoyed by UoA4 researchers:

Brain imaging	EEG facilities in IPS and MRI facilities within the clinical setting (LGI) - a brand new 3T MRI scanner has recently been built that extends fMRI capabilities within Leeds and supports work with GC2,3&4 (e.g. **Wilkie** #1).
Behavioural neuroscience	These laboratories meet the needs of those with expertise in generating transgenic mice, and distinct facilities support multi-species work with behavioural and surgical facilities for rats and mice. GC2 (e.g. **Rodgers** #1).
Clonal sequencing	Consistent, high-quality DNA fragmentation with a Covaris DNA sonication system, and analysis with an Agilent 2100 Bioanalyzer. Sequencing instruments comprise an Illumina MiSeq and Illumina HiSeq2000. Used within GC2 (e.g. **McKibbin** #2).
Reverse Genetics service	A bespoke siRNA screening service, allowing researchers to individually knock down the expression of every gene in the human or mouse genome. Specific end-point assays and high throughput screening technologies (e.g. high content microscopy or fluorimeter) allow quick and easy gene identification. GC2 (e.g. **Inglehearn**; project 6, EU FP7 Training Network).
Molecular neuroscience	State of the art imaging facilities, including light, confocal, TIRF, super-resolution, electron and AFM microscopy with topographical (Ionscope) and high speed confocal (Andor Technology) imaging systems advancing our understanding of GC2 (e.g. **Gamper** #2).
Movement tracking	Three Optotrak systems; Polhemus magnetic head tracker; 3 eye trackers: Eyelink 1000Hz, Tobii and ASL; Xsens inertial sensors; Macreflex in three dedicated laboratories. GC2,3&4 (e.g. **Burke** #1).
Appetite and Energy Balance	A long established human appetite and energy balance research facility with newly developed infant feeding laboratory. This includes purpose built food intake, physical activity and infant nutrition laboratories equipped with state of the art methods for body composition, energy intake and expenditure. GC1,4&5 (e.g. **Caudwell** #1).
Virtual reality and haptics	Moog 3D Virtual Reality Dental simulator (£1.20M), Haptic master robotic arm, 10 Phantom OMNIs, bespoke robotic arms (for stroke and cerebral palsy therapy). GC2&3 (e.g. **Mon-Williams** #2).
Driving simulators	The UoL Driving Simulator (£1.50m) and a virtual reality driving simulator provide world leading facilities for research into driving - a distinctive research theme within GC3 (e.g. **Wilkie** #2).

e. Collaboration and contribution to the discipline and research base: We train undergraduate students to become the researchers of the future (e.g. student input into research findings communication at open days; vacation research studentships each year). This work has been recognised in a UoL partnership award (2012). Success of our BSc/MSc/PhD/D.Clin.Psych programmes is evidenced by our students going on to various external research (e.g. Cambridge, UCL, Institute of Psychiatry) and academic (e.g. Edinburgh, Sheffield) posts.

GC1 Health and Wellbeing are involved in EU scientific policy-making through participation in EC Joint Programming Initiative on Food, Nutrition and Health (**Blundell**); Board of Trustees and Chair of the Scientific Advisory Board for the European Association for the Study of Obesity (**Blundell**) and Board of Trustees for the UK Association for the Study of Obesity (**Hetherington**). Our influence on the industrial sector includes contributions to high-level strategic decision making for several industrial (and industry-linked NGO) R&D programs: including Governorship of the British Nutrition Foundation (**Blundell**); Industrial Advisory Board of Hillshire Brands (**Hetherington**), Wrigley Science Institute (**Hetherington**), Feeding for Life Foundation (**Hetherington**); Academic (**Finlayson**, **Blundell**) and funding panel (**Conner**) membership of the BBSRC Diet Research Industry Club; and Chairing International Life Sciences Institute task forces (**Blundell**: "Energy Balance"; **Hetherington**: "Satiety Benefits").

GC2 The Nervous System and its Disorders members have served on the Wellcome Trust Neurosciences (**Inglehearn**), and MHRA Ophthalmology advisory (**McKibbin**) panels. **Inglehearn**, **McKibbin** are members of the European Retinal Degeneration Consortium; a group of European researchers sharing genetics data/resources. **Peers** is coordinator of the Yorkshire branch of the Alzheimer's Research UK network. **Rodgers** is part of a multi-society working group developing

UK/European guidelines for preclinical behavioural animal research. Close links with the Yorkshire Regional Genetics Service (YRGS) have allowed rapid translation of research findings into diagnostic tests, made available by YRGS to the UK Genetic Testing Network and NHS clinical community (e.g. Case Study 5). We have active links with the Human Pain Research Group (Salford Royal NHS Foundation Trust) and Pain Research Institute (**Lloyd**) and experts in TMS/fMRI imaging at the Universities of Bradford, York, Manchester (**Burke** & **Klepousniotou**). We also lead collaborative work with national and international partners (e.g. University of Western Australia, **Billington**; McGill University, **Klepousniotou;** joint appointment in Hebei Medical University, China: **Gamper**).

GC3 Successful Ageing is centrally involved in a range of key collaborations with external organizations including advisory bodies, funding councils, and academic institutions. We have active links with Age UK, St James LTHT and Chapel Allerton LCHT, and are involved with DeNDRoN (Dementia & Neurogenerative Diseases Research Network) and the Bradford Dementia Group. Through such links, we are part of the local and national network on successful ageing research. We are also leading collaborative work with national and international partners (University of Edinburgh, University of New South Wales, Australian National University, University of Geneva) in exploring stroke recovery (**Mon-Williams**), detection of cognitive impairment & dementia (**Bunce**), working memory and accelerated forgetting (**Allen**), language processing in stroke and dementia (**Klepousniotou**), nutritional factors (**Hetherington**) in ageing, and as part of the European Male Aging Study (**O'Connor**).

GC4 Successful Childhood Development enjoys multiple collaborations and its researchers are actively involved with a range of external organisations. Members of the group are advisors on the NIHR CLAHRC (Leeds, York, Bradford) board for Maternal & Child Health (**Mon-Williams**, **Waterman** & **Billington**). Several members of staff are actively involved in multi-disciplinary collaborative research on the BiB cohort study (**Mon-Williams**, **Waterman**, **Billington** & **Kellar**). We work alongside partners in Industry, for example through the 'Feeding for Life Foundation' (**Hetherington**), which provides online and printed learning resources to healthcare professionals. This GC has built a strategic partnership with Leeds City Council Children's services (**Mon-Williams**, **Waterman** & **L.Hill**), including with the management responsible for implementing educational policy, Senior Educational Psychology Team, and Headteachers of School Clusters. Additional collaborative work is done via the School's Partnership Trust (**Dye** & **C.Lawton**).

GC5 Behaviour Change fit with local and national priorities is reflected in behaviour change-related grants awarded since RAE 2008, attracting funding from: Department of Health (DoH), NIHR, NHS Leeds, Stoke PCT, the Strategic Health Authority, & Unilever. Moreover, the partnership between IPS and the BIHR ensures research findings impact on clinical practice and service delivery at both a local and national level. Staff are theme leaders (**R.Lawton**) and named key researchers (**Conner**, **Kellar**, **Billington**, **Mon-Williams** & **Waterman**) on a CLAHRC2 (Yorkshire) consortium (£10.0m). This GC has strong links with related research in UoA1/UoA2 within the UoL. We have strong links with the users of this research e.g. the local NHS and industry including strategic Knowledge Transfer Partnerships (**Prestwich**, **Conner**, **R.Lawton**, **O'Connor**, **Gardner** & **Kellar**, NHS Leeds; **R.Lawton**, NHS Leeds), PhD studentships (**Conner** & **R.Lawton** e.g. Unilever) and collaborative research (Unilever: **Prestwich** & **Conner**; **Dye** & **O'Connor**).

Mechanisms to promote collaborative research: The UoA4 Research Opportunities Database (ROD) is an online system where academics highlight specific needs and opportunities within research projects. The ROD was first designed to bring together the unique and specialist skills of academic staff, research staff and PhD students within psychology and neuroscience, promoting collaborations that lead to tangible outputs (i.e. high-quality publications and/or grant proposals). Following its success, it has since been expanded to be accessible to staff at BIHR, further facilitating collaboration. The Research Experience Scheme for Undergraduate Students (RESUS) scheme allows Leeds undergraduates to gain invaluable experience working on research projects with staff in psychology and neuroscience. In the process, students gain a greater understanding of how research is performed, as well as developing key skills in the specific areas in which they work. Our researchers are involved in a range of high profile national and international research collaborations across academia, public bodies and industry. These include 14 BBSRC, 13 ESRC, 2 EPSRC, 13 MRC and 16 EU Consortium grants active across REF period. Table summary of

various indicators of esteem or external recognition (N and key examples) across UoA4 below:

Activity	*N*	*Examples*
Awards/Honours	22	Our promotion of research excellence is reflected in awards received: e.g. 2 x Academician of the Academy of Social Sciences; British Nutrition Foundation Prize; Danone Prize; NIH Director's Choice Prize; Physiological Society GL Brown Prize lecturer.
Fellowships	10	Staff support in developing tresearch careers is indexed by awarded fellowships: e.g. Leverhulme, MRC, Royal Society and Wellcome.
Advisory panels/ committees	21	GCs provide a means to describe our research to others, allowing us to provide advice to a number of organisations: e.g. EASO; Food Standards Agency; ILSI Europe Task Force; MHRA ophthalmology; Obesity Review Group, DoH.
Industry advisory boards	11	We ensure our work has impact in industry by contributing via advisory boards: e.g. Bayer, Hillshire Brands; Nestlé, Novartis, Wrigley.
Professional committees	28	We actively engage with professional bodies using a coordinated, strategic approach. Staff sit on a number of professional committees: e.g. Chair, BPS Journals Committee; Deputy chair, BPS Research Board; President, International Society for Arterial Chemoreception.
Conference organisation	23	Our goal is to contribute to the research field through strategic conference organisation: e.g. BPS Annual Conference; British Pain Association; EU-NIH Task Force on Biotechnology Research Symposium; International Conference on Memory; International Workshop on Obese Species; UK Society for Behavioural Medicine.
Conference chairs	13	UoA4 staff are highly respected researchers as reflected in being conference chairs: e.g. British Neuroscience Association; European Congress on Obesity; European Health Psychology Society; Society for the Study of Ingestive Behavior.
Invited keynote lectures	40	We disseminate our findings in world-leading (interdisciplinary) conferences via keynote talks: e.g. American Dietetic Association; European Congress on Obesity; European Health Psychology Society; North American Association for the Study of Obesity.
Grant committees	14	We sit on major grant awarding bodies allowing us to align our GCs with strategic priorities: e.g. BBSRC - Diet and health; BBSRC - DRINC; Heart Research UK; International Association for the Study of Pain; MRC - Lifelong Health & Wellbeing.
Journal Editorships/ Associate Editors	22	We place a strong emphasis on staff contributions to high impact journals as shown by editorships (Psychology & Health) and associate editorships (e.g. Appetite, European Journal of Pain; Journal of Alzheimer's Disease; Journal of Medical Internet Research).
Editorial Boards	40	Our strong emphasis on staff contributions to academic journals is shown by extensive editorial board membership: e.g. Behavioural Brain Research; Health Psychology; International Journal of Obesity; Journal of Applied Psychology; Physiology & Behavior.
National grant reviews	45	We support the UK's research infrastructure by providing time for staff to review grant applications for a large range of funders (N=45): e.g. British Heart Foundation; BBSRC; ESRC; Leverhulme; MRC; NHS/DoH; Nuffield; Royal Society; Wellcome.
International grant reviews	19	We underpin international science by reviewing grants for various overseas grant awarding bodies e.g. Australian National Health and Medical Research; Canada: Natural Sciences and Engineering Research Council, Social Sciences & Humanities Research Council; Netherlands: IWT, NOW, ZonMw.