

<b>Institution: Plymouth University</b>
<b>Unit of Assessment: UoA4</b>
<p><b>a. Overview:</b> Psychological research centres on the work of the University-recognised Centre for Brain, Cognition and Behaviour (CBCB), whose three overlapping and interacting research clusters are its engine of research activity. The <i>Brain</i> cluster is concerned with the cognitive neuroscience of language, memory, perception and attention. The <i>Cognition</i> cluster explores language and cognitive development, memory and learning, animal cognition, and thinking and reasoning. The <i>Behaviour</i> cluster investigates health and well-being, human factors, and applied decision making and judgement. The Centre is a core component of the Plymouth University Cognition Institute, which brings together staff with interests in cognition from the Arts, Sciences, Health, and Human Sciences into a unit with a broad cross-disciplinary focus and an outward-facing role.</p> <p>While research activity is managed through CBCB, members of staff are appointed to teach in Schools. Consequently research activity is managed by a combination of Centre-based (e.g., research mentoring, peer evaluation) and School-based (e.g., workload policy, appointment strategy) mechanisms and policies. Coherence between Centre and School agendas is achieved by the appointment of the Centre Director as Associate Head for Research in Psychology on the School Management Committee.</p> <p>Since 2008, there has been a considerable development of research capacity at Plymouth. We have refurbished our teaching and laboratory facilities through a £4m building project, reconfigured our research activity around a new research Centre and Institute structure, invested in our laboratory infrastructure, and pursued active research-led recruitment and staff development policies. Our success is demonstrated by the doubling of our annual research expenditure over the period, from an average of £321K per annum over the 6 full years of the previous RAE period, to £814K per annum over the equivalent period this time, with substantial awards in 2013 (£4.1m from the Marie-Curie Training network, and £879K from the ESRC) consolidating this trend for the future.</p>
<p><b>b. Research strategy:</b> Our strategy is based on an assessment of the requirements for vibrant and sustainable research excellence in Psychology. This requires research strength across a sufficient range of the subject to remain responsive to future strategic developments in the discipline at national and international level. It also requires maintaining a balanced profile of senior academics (to provide leadership and support) and early career researchers and PhD students (to ensure succession planning). Critical mass in areas of strength enables us to attract and retain excellent research staff, and to support their work in a suite of high-standard specialist laboratory facilities, supported by dedicated technical staff. This permits the attraction of research funding and so generates high quality outputs and impact. A sustainable culture must be maintained through a collaborative and supportive working environment that ensures all members of staff are involved in productive collaborations in a research cluster rather than working in isolation. It also enables us to be responsive and flexible in developing large-scale cross-disciplinary funding bids.</p> <p>To address these requirements, the area of research activity submitted to UoA44 in 2008 was restructured as part of a University-wide strategy to focus on areas of research strength at Plymouth University. Central to this was the creation of a research Centre in Brain, Cognition and Behaviour (CBCB) to build on the strength in ‘Cognition’ that the RAE panel had commended. This remains fundamental. ‘Brain’ was selected as a key area for three strategic reasons: it links coherently with, but builds upon, our strength in cognition, it is a growing topic of national and international scientific research, and it supports the University’s research agenda by facilitating collaboration with neuroscience research in the Peninsula Medical School and robotics and neural systems research in the School of Computing and Mathematics. ‘Behaviour’ was selected as a key area to build on our established strength in Health and Applied Cognitive Psychology and now focuses on issues of behaviour change in health and well-being (through collaboration with the Medical School, and the Faculty of Health and Human Sciences) and sustainability (in collaboration with the University’s Institute for Sustainability Solutions Research, ISSR). ‘Behaviour’ was also identified as a potential vanguard for developing our future research impact.</p> <p>The consolidation of research around the 3 core areas of CBCB has been achieved through strategic appointments of new staff (section c below) and tightly coupled investment in</p>

infrastructure and equipment (section d below). A key element of our strategy has been to recruit and support excellent researchers with strong backgrounds in neuroscience methodology, to work with researchers with strength in cognitive psychology. Consequently, the major focus has been on developing cognitive neuroscience. This process began with the appointment of **Roser** in neuroimaging, **Goslin** in ERP and EEG, and **Denham** in computational neuroscience at the end of the last RAE period. Subsequently, we have appointed **Bach** and **Schendan** in ERP and neuroimaging, **Ganis** in ERP and Transcranial Magnetic Stimulation (TMS), **S. Hall** in neuroimaging and TMS, **Patterson** in neuroscience of audition, and **Terbeck** in social neuroscience. These appointments have built a vibrant neuroscience research culture whose members work closely with those with expertise in Cognition. The Cognition area has also seen major development over the period with recruitment of staff to further strengthen research activity in Learning and Memory: **Mitchell**, **G. Hall**, and **Jones** in associative learning, **Wills** in learning and categorisation, **Berry** in mathematical modelling of memory systems, **Longmore** in memory and face processing, and **Wimmer** in memory development. This has been strengthened through **Cai** and **White** in psycholinguistics and through the membership of animal cognition specialists **Briffa** and **Brilot** from the School of Biological Sciences. New appointments in the Behaviour cluster are **Bessell** in health and clinical psychology, **Deeproose** in psychopathology, and **Kirsch** and **Whalley** in health psychology. **Calvini's** expertise in social cognition strengthens our capacity in social psychology and links Behaviour to Cognition, whilst **Terbeck's** work links Behaviour to Brain.

The creation under Denham's leadership in 2012 of a University-wide Cognition Institute, with central financial support from the University of £130k per annum, established a powerful interdisciplinary research hub. The Institute brings together leading researchers in experimental psychology, cognitive science, cognitive robotics, computational modelling, biomedicine, the humanities and the creative arts with the aim of fostering large-scale multi-disciplinary and multi-site collaborative research projects. It has an outward-facing agenda through scientific events such as the Dana Foundation Brain Awareness Programme that is open to the public, monthly public CogTalk seminars, and International workshops such as Making Sense of Sound, NeuroArts 3, and Music, Science and the Brain. Formally launched in March 2013 with its first annual conference, it liaises closely with regional Schools and is currently engaged in the development of meaningful, long term projects between the University, local Schools, STEM Ambassadors, and Cornwall Learning. The Cognition Institute has already been awarded a €4.1m mono-site Marie Curie Training Network that comprises an Institute-wide consortium and over 20 international collaborators. 26 fully-funded PhD projects (14 grant-funded, and 12 University-funded) will start in January 2014 and will greatly enhance our future research capacity.

Another strategic goal is to broaden the reach and impact of research. **Edworthy**, a senior academic with experience in applied research, leads this strategy and is a member of the School Management Committee. She organises seminars and training on sources of funding and forms of engagement and ensures that staff engage with the University press-office to promote their research activity. This involves utilising academics who have been successful in winning tenders and other funding, including KTPs, and helping colleagues to write research articles for professional journals and websites targeting a broader audience. As a result, **Auburn** has written a paper on community justice aimed at the Probation service and **Hyland** has written a health-care guide for Respiratory care professionals. Academic staff members are encouraged to participate in interdisciplinary and professional conferences and professional meetings where policy and practice may be developed. Provision is made for this in workload allocations, and a dedicated budget is available to support it. Examples are **Pahl's** talks on sustainability to the Energy Savings Trust and the Carbon Action Network, **Perfect's** keynote address to the London Metropolitan Police Annual Identification Conference, **Edworthy's** talk at the Association for the Advancement of Medical Instrumentation, and **Hellier's** speech at the Civil Contingencies Secretariat Warning and Informing Workshop at the Cabinet Office Emergency planning College. KTP applications are supported by a dedicated project manager from the University's Research and Innovation office, who both supports the application process, and the subsequent monthly team meetings and formal reporting. This strategy has significantly increased our KTP funding, with 5 awards being held in the period.

Broad and overlapping research clusters with a core-strength of research leaders at Reader / Professorial level provide a dynamic environment for researchers and ensure the effective delivery of our strategy. Collaboration across clusters is common, with individuals from different clusters co-supervising PhD students and being jointly involved in funded research projects and shared use of laboratory facilities. Groups of staff and postgraduates also meet regularly to hold thematic 'lab' meetings and discussion groups across the spectrum of the Centre. Additionally, both the School and the Cognition Institute host annual conferences and weekly seminars by external speakers open to all Centre staff and postgraduates.

A key priority for the next 5 years is to invest and strengthen the Behaviour strand of our research centre. Our intention remains to consolidate research in the two themes of Health and Well-Being, and Sustainability that address key national agendas. Early career researchers (**Bessell, Deeprise, Whalley**) have been appointed in Health Psychology and we will develop and support their careers. This research will also benefit from interdisciplinary collaboration following the move in August 2013 of the School of Psychology into the Faculty of Health and Human Sciences. **Hyland** has been appointed to develop research collaborations with the new Schools of Medicine and Dentistry at Plymouth and to facilitate translation of basic health research into medical impact. A significant step forward for Sustainability has been the award in 2012 of a £1.8M EPSRC grant to **Pahl**, who is leading a multi-disciplinary, multi-institution project aiming to reduce energy wastage. This has helped to cement the collaborative links with the ISSR, and fits well with Plymouth University's broader strategic research agenda, and its standing as one of the UK's greenest universities, as indicated by the People and Planet Green League of Universities, 2012. We intend to build on this success through strategic appointments in this area as the opportunities arise.

**c. People: Staffing strategy and staff development.** A key element in developing our research capacity has been the strategy of appointments to our core research clusters, aimed at maintaining a critical mass of research across the breadth of the Centre and maximising opportunities for collaborative research. All new appointees are required to demonstrate a track record of international quality publications, external research funding success (or the potential for success if ECR), and impact potential indicative of their ability to contribute to future success at Plymouth. We have appointed at all levels of seniority in each of our clusters. However, sustainable research excellence cannot be achieved through recruitment alone and we have developed policies and procedures to create a research-led culture that supports and develops our research staff and postgraduate students, in line with University policy. Overall responsibility lies with the Centre Director, who sits on the School Management Committee and on the Faculty Research Committee. Involvement of the Centre Director in decision making on all policy matters relating to research, including staff recruitment, workload, and teaching policies, ensures coherence in approach between the Centre and the School. The Centre Director is also jointly responsible with the Head of School for research budget decisions and for running staffing policies in support of research, and chairs the School's Research Committee, which reports to Faculty and University-level research committees and represents the Centre on the Board of the Cognition Institute. Members of the Research Committee also sit on the Faculty Research Ethics Committee. The multiple roles carried out by the Centre Director ensure that the research activity of the Centre is informed by, and aligned with broader research policies in the Institute, Faculty and University.

Numerous dedicated research budgets support research activity within the Centre. The Centre Director has an annual budget to support small-scale research consumables requests of up to £500 per bid which can be awarded without the need for further consultation, typically covering conference travel, small equipment bids, consumables or participant payments. The School Research Committee administers a separate, larger annual pump-priming budget (c. £30K pa) that typically funds experimental work in support of grant applications, high-quality publications, or travel to support international research collaboration. There are also central University-funded schemes to pump-prime research activity. **Ganis, Hanoch** and **Pahl** were awarded International Research and Collaboration grants under this scheme to establish international links with the Universities of Padova, Berlin and British Columbia. **Hanoch** and **Hellier** have also received funds through the VC's Community Research Awards scheme to support local community-based research projects.

Research is also supported in other ways within the School and Centre. For instance, staff can bid to the School for funding to cover costs of scanning time on the 1.5T MRI scanner that is used jointly with the University of Exeter (**Roser's** output 2 was funded in this manner). The School employs 8 Teaching and Research Assistants, 5 of whom are registered for a part-time PhD. In addition to providing a funding mechanism for PhD studentships, these roles provide research support to academic staff outside the teaching timetable. Academic staff can bid for TARA support to help with any aspect of research activity. A member of the School Management team manages the bids to ensure that the workload is appropriate, and commensurate with their PhD studies. Research support is also provided through the School's commitment to providing undergraduate students with practical research training. Each year the School covers the costs of up to 15 undergraduate students for a 36-week research-placement during the year prior to their final year of study, working closely with a research supervisor, and becoming fully-fledged members of a research team. During term-time, undergraduate students from any year can volunteer to support research as part of a research-apprentice scheme, collecting data for on-going research projects and contributing to research team meetings and seminars. The School also runs a funded summer-intern scheme for up to 12 projects, paid at the same rate as similar national scheme funded by the Experimental Psychology Society. These pay for a research-assistant for up to 10 weeks over the summer and are typically used to pump-prime grant applications or facilitate publications. In addition to these schemes, members of staff who have generated external funding are allocated 25% of the funds associated with their FEC costs into a strategic research account that can be used to fund research-related activity. The School has also appointed 2 fixed-term postdoctoral fellows with no teaching duties beyond research supervision who work collaboratively with other academic staff to generate research grant applications and research outputs.

In addition to the School-based research budgets and resources, a number of other policies support research activity, and staff development in research. Newly appointed staff are given a reduced teaching load in their first year of post, to provide them with time to establish their research activity in Plymouth and are offered start-up funds and equipment to enable them to kick-start their research on arrival in Plymouth. These are negotiated individually on appointment, and the amounts vary with seniority and research area. ERP and TMS laboratory facilities for **Ganis**, **Schendan**, and **Hall, S** were established in this manner. New appointees are also allocated an informal 'mentor' to smooth the transition to Plymouth, help ranging from explaining the lab-booking system through to helping to draft UK grant applications, reviewing papers, or networking on their behalf. New staff members are also allocated to supervision teams for PhD studentships. This provides training opportunities for early career researchers, and enables them to collaborate with established researchers. The School runs a sabbatical scheme, for 6-month periods of leave from teaching and administrative duties. Staff are eligible to apply every 4-5 years (depending upon demand) and applications are assessed (and final reports evaluated) by the School Research Committee. Over the REF period, sabbaticals have been taken by 20 different individuals (**Ellis**, **Hellier**, **Walsh** in 2007/08, **Edworthy**, **Wyer** in 2008/09, **Perfect**, **Roser**, **Verde** in 2009/10, **Andrade**, **May**, **Pahl**, **Symes** in 2010/11, **Floccia**, **Goslin**, **Tucker**, **Auburn** in 2011/12, and **Hanoch**, **Gummerum**, **Simpson**, **Hyland** in 2012/13).

All external grant applications are independently peer reviewed by members of the Research Committee. This provides peer-review and feedback to staff making applications, promulgates good grant-writing practice in the Centre, and ensures the quality control necessary for demand management of external funding applications. This constitutes the first stage in a University-wide system of grant-application scrutiny and demand management operated by the Research and Innovation Division.

In line with University policy, all members of staff within the Centre, from Professors to postdoctoral researchers and research assistants, meet annually for an individual Performance Development Review meeting with a senior academic colleague appointed by the School Management Team. At this meeting, past research performance and future research plans are discussed in connection with School / Centre and University objectives, and new objectives are agreed. Where appropriate, training needs are identified, and supported from School funds as

necessary. The process is also used to support and guide staff towards promotion. Over the period of the REF, 9 individuals in the Centre have been promoted (**Denham & Ellis** to Professor; **Briffa, Floccia, Gummerum, Hanoch, Pahl, Schendan & Wyer** to Reader).

The University was awarded the EU HR Excellence in Research Award in 2011 for implementing the Concordat to Support the Career Development of Researchers. The Centre fully engages with the Concordat and gives support with networking, writing papers and grants, giving conference papers, and making job applications. Researchers and ECRs are fully integrated into, and benefit from the research culture of the Centre. In line with University policy, the School of Psychology is committed to ensuring equality and diversity issues are properly addressed in all aspects of its work and the School was recently awarded an Athena SWAN Bronze award in recognition of its commitment in this area. For example, with respect to recruitment, all members of staff have to pass an Equality and Diversity training course, all Chairs of hiring panels must pass a two-day training course before appointment, and all selection panels must include a female member of staff. The School has an Equality and Diversity officer (**Gummerum**) responsible for monitoring and reporting compliance with University equality and diversity policies in all areas of the work of the School. In the period, 6 of the 9 promotions went to female members of staff.

A number of informal mechanisms of research support and staff development are crucial to the development of a vibrant research culture. For instance, many self-organising groups of researchers share research interests and meet regularly to discuss recent papers, plan grant applications, hear practice conference talks, discuss the latest data from one of the labs and so forth. These meetings provide a collegiate environment for academics, research staff, postgraduate students, and undergraduate research-apprentices and provide an excellent forum for provision of training and support for early career researchers: for example PhD students usually give practice talks at these meetings, and receive feedback from a range of staff. The meetings also provide a way of encouraging collaborative research across research clusters. During term-time weekly seminars by high-profile external speakers are open to all staff and postgraduate students. Speakers are chosen on the basis of their potential to support existing research activity within the Centre, and postgraduates are encouraged to attend and to network with our visitors.

Members of staff in the Centre are involved in ad-hoc activities that help to create a dynamic research environment. For example in 2011, **Hanoch** was awarded a University Networking grant to fund a Plymouth-based conference entitled 'Bounded rationality: Decision making and risk taking in the real world', with external speakers from the Berlin ABC Group, LSE, Cardiff, and Surrey. In 2012 **White** received funding from the Experimental Psychology Society to host a workshop on 'Dynamics of Conversational Engagement', which included external speakers from across Europe. The School has also hosted 2 EU Cognition-funded international summer Schools ('Auditory Cognition, organised by **Denham** in 2012, and 'Bilingual Minds, Bilingual Machines', organised by **Floccia** in 2013).

**Research students:** The Centre hosts a dynamic community of Research PhD students: on 1<sup>st</sup> Oct 2013 35 students were registered for a PhD degree (20 FT, 15 PT), together with 30 on clinical doctorates, with 4 more awaiting a viva. These students are a vital component of the research culture of the unit: they are active and full members of all our research sub-groups, and they collectively organise the annual School conference through a PG-only organising committee responsible for soliciting presentations, inviting a keynote speaker, selecting papers and posters, and awarding prizes. The event is open to all members of the Centre, and presentations are given by both academic staff and postgraduate students.

All PhD students are provided with bespoke training based on modules from the MSc in Psychological Research Methods tailored to the needs of the students. Modules cover a broad range of research skills, including experimental design, advanced statistical analysis techniques, qualitative methodologies, programming, and communication skills. Research students, in conjunction with their supervisors, identify their training needs at the outset of the PhD and take those MSc modules that meet their individual needs, supplementing this with externally-provided training where necessary, including that provided by the Social Sciences Doctoral Training Centre

and University Graduate School. All students are allocated an annual budget to support their research, regardless of funding source.

Every PhD student has a Director of Studies and at least one other supervisor, as well as support from the School's Postgraduate Tutor. Joint supervision meetings are arranged on a regular basis, at the instigation of the student, but normally on a fortnightly basis in the first instance. Performance against key targets and milestones is recorded in a PhD e-logbook by students and their advisers, and is monitored by the Graduate School. Students normally initially register for an MPhil degree and transfer to a PhD route upon approval of their transfer report by an 'expert commentator' external to the supervisory team. Additionally, the Postgraduate Tutor meets with all PhD students annually to discuss their progress, satisfaction, and resource needs.

The ESRC's creation of a small number of Doctoral Training Centres in 2010 removed any opportunity of us competing for ESRC studentships and so created a challenging funding environment. A priority during this period has been to seek alternative funding streams. One source is internal funds from University, Faculty or School and such funds have been used to fully fund 19 studentships (with 4 more having started in September 2013), and partially fund another 5 as part of joint-funding schemes with external agencies. Additionally, the School has invested in 8 part-time teaching support posts, with post-holders registering for a part-time PhD for the duration of their contract. A second part of our strategy has been to seek to develop external sources of funding. One outcome of this strategy is the Marie-Curie Training Network funding which will provide 14 fully-funded PhD places starting from January 2014 (with 12 more funded internally). We have also been developing links with Universities overseas and are in discussions with King Saud and Princess Nora Universities in Saudi Arabia for joint supervision programmes in Psychology, and the first student has joined the School in September 2013. Additionally, in 2013, the clinical psychology doctoral programme was brought fully into the School of Psychology, to form an integral part of our research postgraduate community. As a result of these initiatives we expect to significantly enhance the size and scope of our research postgraduate community in the medium term.

**d. Income, infrastructure and facilities:** In the RAE period to July 2007, research expenditure associated with the Psychology bid was £2.26M. In the current REF period, we have seen considerable growth in our income. Members of staff in CBCB have been PIs on new grant awards held at Plymouth totalling around £8.86M. Expenditure during the period has been less than this (£4.07M), largely because a substantial proportion of our grant awards are relatively recent, and the planned expenditure will take place beyond the current REF period: in 2011 **Pahl** was awarded £908K for the EPSRC grant EViz, in 2013 **Floccia** was awarded £879K for an ESRC grant on Lexicon development in bilingual toddlers and **Denham** was awarded €4.1M for the EU Marie-Curie Training grant CogNovo. Several staff who joined CBCB within the REF period have also acted as PIs to grants awarded whilst they were employed at their former Universities, in many cases overseas (e.g., **Ganis, Hall, G, Hall, S, Jones, Mitchell, Wills**), with these awards totalling £1.75M. Members of the Centre (**Andrade, Ganis, Hall, G, Hall, S, Kirsch, May, Mitchell, Perfect, Schendan, Wills**) have also been co-investigators on multi-disciplinary grants awarded either to PIs based elsewhere in the University (£2.01M), or at other Universities in the UK, and overseas (£6.89M).

A period of sustained investment into the research infrastructure for Psychology has underpinned the research strategy of CBCB. In 2008 the School's teaching and research facilities were upgraded in a £4M building project. It now houses 35 separate laboratories, the majority of which are designed for flexible use and are bookable through our online laboratory management system. Subsequent investment has been made in specialist laboratory refurbishment, with a particular focus on developing our capability within the Brain research theme that remains central to our research ambitions.

The Brain research facilities include laboratories for the direct measurement of brain activity via changes in blood oxygenation, using a two-channel functional near infra-red spectroscopy (fNIRS) system (Oxiplex TS, ISS), used primarily by **Simpson** in the Vision Research Laboratory, alongside psychophysical methods. The study of visual neuroscience is supported by three fully-

equipped eye-tracking and gaze analysis facilities, including an SMI Red50, an SMI RED500 and an SMI RED-M mobile (SensoMotoric Instruments), used by **Harris** to investigate visual development and neuropathology and by **Floccia** for paediatric neurodevelopment. Research into the temporal structure of brain activity is supported by a comprehensive range of EEG facilities including three fully equipped 128-channel active-electrode EEG laboratories, two ActiveTwo systems (Biosemi), and one Brainamp/Acticap system (Brain Products). These laboratories each have twin-recording rooms running with high-resolution CRT monitors for stimulus presentation which enable focal ERP recordings as part of research programmes in vision and memory (**Schendan**), social cognition (**Ganis**), language processing (**Goslin**) and vision and action (**Bach**). Further research focuses on the role of neuronal network oscillations in sensorimotor function (**Hall, S**), incorporating collaborative use of the 306-channel Triux MEG system (Elekta Neuromag) at Aston University.

In support of our strategy of developing multimodal neuroimaging, we established in 2013 the Neural Modulation laboratory. This brain stimulation facility houses two single-pulse TMS systems (Mastim) for multi-site single- and paired-pulse stimulation and a Magstim rapid rTMS system. In addition, there is a transcranial direct current/alternating current stimulation with two and five site configurations (Neuroconn). Combined brain stimulation and recording is made possible using either a TMS/tDCS/tACS compatible 64-channel DC-EEG NeuroPrax system (Neuroconn) or two 64-channel passive amplification EEG systems (one SAI and one Brain Products). Head and brain positioning is facilitated using a stereotactic TMS navigation system (Zebris Medical). Multimodal co-registration of EEG, TMS and MRI/fMRI is further supported by 3D scalp surface and electrode digitization using Patriot and Isotrak systems (Polhemus). This enables optimized source localization in multimodal studies. Current research programmes are exploring sensorimotor function (**Hall,S**) and the neuropsychology of reasoning (**Roser**).

In support of these activities, a battery of additional devices is available, including physiological measurement using several multi-channel EMG systems, respiratory belts, skin thermometers, GSR devices and pulse meters. There are also movement measurement devices, including force transducers, accelerometers and laser displacement meters. Finally, somatosensory and pain research devices enable peripheral percutaneous electrical nerve stimulation (Digitimer). These devices are central to the vision and action (**Bach**) and sensation and pain (**Hall,S**) research programmes.

Development of the multimodal neuroscience facilities in collaboration with brain researchers from Peninsula Medical School and with computational neuroscientists is a core element of the Cognition Institute strategy. In 2013, the University committed £2Million to create a University Brain Centre including a 3-Tesla MRI system that provides improved capacity to obtain anatomical MRI, fMRI, MRS and DTI measures alongside those already available at Plymouth. This is a collaborative venture with the Peninsula Medical School and Derriford Hospital NHS Trust. At present, MRI scanning facilities are available through collaborative use of a 1.5T Intera system (Phillips) at the University of Exeter.

The research in our laboratories is supported by a team of 5 dedicated technicians, with the skills and experience to provide customized software and hardware support for the various projects. The technical team supports the 95-networked computers within the centre for behavioural testing and data analysis. In addition, there are a number of dedicated multi-core workstations in the specialist laboratories and the School houses a dedicated data-analysis laboratory. There is a comprehensive suite of fully supported software for stimulus presentation (e.g. ePrime, Presentation), analysis of fMRI, EEG and TMS data (e.g. BrainVoyager, EEGLab, ERPLab, SPM, AFNI, EMSE Suite,) and general programming environments such as Matlab.

The other major area of investment since 2008 has been the development of a specialist infant research lab (the 'Plymouth BabyLab'). In 2012 an investment of £100,000 was used to rehouse and re-equip the BabyLab into large dedicated facility consisting of a family-friendly reception space, two observation rooms and 6 individual sound-attenuated booths equipped with 500Hz eye-tracking, inter-modal preferential looking procedures, head-turn procedures, and NIRS capabilities.

All researchers working with children (in the BabyLab or in local Schools) or with vulnerable populations are required to obtain a CRB check, paid for by the School.

**e. Collaboration and contribution to the discipline or research base:** Members of academic staff in CBCB have made a broad contribution to the discipline of Psychology in the REF period. Fifteen have served as editors, associate editors, or members of editorial boards for international journals, including *Psychological Review* (**Evans**), *Journal of Experimental Psychology: Human Perception and Performance* (**Hall, G**), *Journal of Experimental Psychology: Applied* (**Edworthy**), and *Health Psychology* (**Hanoch**). The majority (29) of staff in the Centre have reviewed grants for one or more of the Research Councils, major charities, or international funding agencies during the period, with many staff reviewing multiple times, or for multiple funding bodies. Twenty-one people have acted as a grant reviewer or rapporteur for the ESRC, with equivalent numbers for other funding sources as follows: AHRC (1), BBSRC (8), MRC (6), EPSRC (6), NERC (1), Charitable foundations (5), European funding schemes (10), US funding (10), Canadian funding (7), Israeli funding (2), and Australian funding (2). Most staff (27) have given invited seminars at Departments around the UK (e.g., Birmingham, Bristol, Cambridge, Oxford, UCL), and overseas (e.g., in Australia, Canada, China, France, Germany, Italy, Japan, Spain, USA), with many staff giving multiple talks at different venues. Twenty-six have also been invited to take part in symposia at international conferences, again with many multiple invitations during the period. Eight members of the Centre have given keynote addresses at national and international meetings and workshops and 10 have organised symposia at conferences at workshops. Seven members of staff have organised entire meetings, including meetings of the Experimental Psychology Society, and an international meeting in Spain. Thirteen members of staff have acted as an external PhD examiner during the period (with several staff doing multiple examinations), including 12 PhD's awarded overseas.

The research contribution of individual staff in the School has been recognised in many ways. During the REF period, both **Andrade** and **Edworthy** were awarded the status of Academician of the Social Sciences. **Andrade** was also recruited as a consultant for the Science Museum's exhibition 'Pain Less', open from November 2012 to August 2013. She was appointed to the steering panel of the 5th National Audit Project on Accidental Awareness during General Anaesthesia in the UK. She and **May** were both appointed as visiting Professors at Queensland University of Technology. **Edworthy** was appointed to the IS/35 Health Informatics Technical Committee as an expert on alerts and user interface on behalf of the British Standards Institute and as a member of the American Association of Medical Instrumentation medical device alarms committee. **Evans** was invited to write an overview of his field for the *Annual Review of Psychology*, now the second highest cited Annual Review paper in the period. **Ganis** is a founding member of a European Consortium on psychological research on deception detection. **Hall, S** was awarded a patent with Regen Therapeutics Plc. (The GABA-A alpha-1 subunit modulator 'zolpidem' as desynchronizing agent for use in neurological disorders). **Handley** is on the ESRC's Training and Skills Council and is Chair of the ESRC Early Research Leaders Sift and Commissioning Panels. **Hellier** was recruited to the NHS Service Delivery and Organisation Commissioning Board, the MRC College of Experts (Health Services and Public Health Research Board), the MRC College of Experts (Efficacy and Mechanism Evaluation Program) and the IST/35 Health Informatics Technical Committee as UK expert on alerts and User Interface on behalf of British Standards Institute. **Hyland** helped to develop the National Service Framework (NSF) for Chronic Obstructive Pulmonary Disease, and was a contributor to the International Primary Care Respiratory Group policy statement on Difficult Asthma, in 2012. **Patterson** was invited to give an address to the Acoustical Society of Japan, and was a visiting researcher at Google Inc. in California. **Perfect** was elected Honorary Treasurer of the Experimental Psychology Society, to the Governing Board for Society for Applied Research in Memory and Cognition, and was made a visiting Professor at Flinders University. **Simpson** was a member of CIE (Commission Internationale de l'Eclairage) Technical committee T 1-60 Contrast Sensitivity Function for Detection and Discrimination. **Terbeck's** paper "Propranol reduces implicit negative racial bias" was identified by Springer as their most widely discussed Neuroscience paper in 2012 (<http://www.springer.com/biomed/neuroscience/neurostars?SGWID=0-1751113-0-0-0>).

The Centre has hosted a number of international visitors who have spent extended periods working here in support of its network of collaborative research. These include Prof. Valerie

Thompson and Prof. Jamie Campbell (University of Saskatchewan), Prof. David Kavanagh (Queensland University of Technology), Dr Rodriguez Galda (Universidad de Granada), Dr Marta Straga (University of Trieste), and Prof. Friedemann Pulvermuller (Freie Universität Berlin). Members of the Centre are also encouraged to visit overseas laboratories in support of collaborative projects, and to enhance our research reputation internationally. Visits include **Briffa** (UC Davis), **Denham** (Hungarian Academy of Sciences), **Evans** (University of Washington, as an endowed visiting lecturer), **Ganis** (University of Padova), **Gummerum** (University of Toronto), **Hanoch** (University of Zurich), **Hall, G** (University of New South Wales), **Pahl** (University of British Columbia), **Patterson** (University of Wakayama), **Perfect** (Flinders University as a visiting Professor, funded by Flinders University), **May** and **Andrade** (Queensland University of Technology, as adjunct professors funded by QUT) and **Walsh** (University of Trieste).

Members of staff in the Centre have collaborated extensively with research groups from around the world on funded projects from a range of sources. Nine members of staff have been involved in 28 separate funded projects held elsewhere, with a total value of over £8.62M. These include **Denham** who was a Co-I on an EPSRC / BBSRC funded project with a number of industrial advisors (BABEL, value £1.67M). **Ganis** has received funding from the US Government and NSF totalling (as PI) totalling £687K. **Kirsch** has been a Co-I on two large-scale NIH-NCCAM funded projects in the US, with a total value of £4.6M. **Mitchell** has been involved in three funded projects from the Australian Research Council (one as PI), with a total value of £456K, **May & Andrade** were associate investigators on an Australian NHMRC grant worth £266K. **Schendan** was Co-I on an US National Institute of Neurological Disorders and Stroke project worth £437K. **Hall, G.**, **Hall, S.** and **Wills**, were all funded by UK and European funding agencies whilst based at their former institutions, and collectively were involved in 13 funded projects totalling £1.9M.

During the REF period there has been considerable media interest in the research carried out in the centre, and 19 academics in the centre have actively engaged in media engagement both in the UK and overseas. Work from staff in the Centre has featured on Television (e.g., BBC news, CNN, Channel 4 news, ABC Canada), radio (e.g., BBC Radio 4), magazines (e.g., *New York Review of Books*, *New Scientist*, *Science*, *Scientific American Mind*), newspapers (e.g., the *Daily Telegraph*, *Guardian*, *Independent*, *Times*, *New York Times*, *Wall Street Journal*, *French Tribune*, *Le Figaro*, *Washington Times*, *People's Daily* of China) and online (The Jury Expert, Business Week, USA Today). **Briffa** has been a presenter on the "Naked Scientists" radio show. **Kirsch's** book *The Emperor's New Drugs* (2011) had an enormous impact, and was reviewed in *New York Review of Books*, *Scientific American* and *Times Higher Educational Supplement* amongst others. **Terbeck's** paper on the effect of propranolol on implicit racial bias resulted in 30-40 media interviews worldwide.

Members of staff actively collaborate with non-academic users and commissioners of research. Within the REF period, **Hellier** has grant funding from NHS Connecting For Health (£80K), Greenstreet Berman Ltd/Rail Safety & Standards Board (£20K), and Home Office/Cabinet Office (£62K). She also supervises 3 jointly funded PhD studentships with commercial / business partners: Howmet Ltd, Hewlett-Packard Labs, and The Health and Safety Executive. **Wills** has funding from Qinetiq for two security-related projects (£392K and £60K), and **Ganis** has a large security project funded by the US Government (£543K).

Members of staff also work with non-academic users projects either funded internally, or on activities that require no funding. **Pahl**, **Andrade**, and **May** have University of Plymouth funding totalling £182k to fund joint projects with the Plymouth Dental School. **Simpson** is collaborating with radiologists at Derriford hospital on project on detecting cancerous cells in mammograms, with a University of Plymouth funded studentship awarded in 2012 to pilot the project. **Wimmer** is working with Warwickshire Educational Psychology Service on the role of mental imagery and pictorial representational understanding in an educational setting. **Bach** was involved in a Unilever-sponsored cognition workshop in 2009. **Denham** is working with Cornwall Learning and with the Dana Foundation Brain Awareness programme to develop outreach activities for schools in the South-West region. **Edworthy** gave an invited presentation on alerting through sound to the Cabinet Office Civil Contingencies Secretariat Cell Broadcast Feasibility Working Group. **Hellier** gave an invited presentation to the Cabinet Office (Civil Contingencies Secretariat), at the Emergency Planning (Warning and Informing) Workshop, July 2009.