Institution: University of St Andrews

Unit of Assessment: UoA 04: Psychology, Psychiatry and Neuroscience

Section 1. Unit context and structure, research and impact strategy

Who Are We?

All staff submitted for UoA4 (32.1 FTE) are members of a vibrant, collegiate and world-leading School of Psychology and Neuroscience (P&N). We consider ourselves distinctively inter-disciplinary. The School delivers wide-reaching advances in research and teaching across the breadth of psychology and neuroscience. This is made possible by our unique ability to genuinely bridge fields; from cells to minds to crowds. We believe that the most important and impactful progress in these fields results from a 'joined up' approach. We achieve this by maintaining and developing four distinct, focused, yet interlinked strategic areas for research (see figure 1): Social and Group Processes ('**Social**'); Perception, Cognition and Action ('**Cogact**'); Origins of Mind ('**Origins**'); and Cellular and Behavioural Neuroscience ('**Neuro**'). Our key research strategy is to deliver depth by focussed activity in selected areas, whilst offering breadth by collaboration: across disciplines within the School, across the University, and with the very best scientists and scholars across the world.

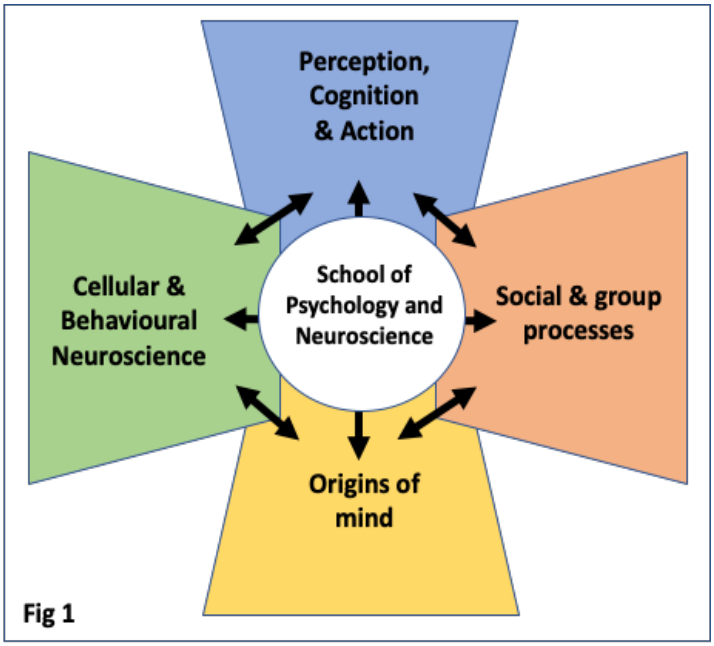


Fig 1

Research Groupings

(appointments in REF period in *italics*, ECR in **bold**, * partial FTE)

Our research is hosted via 4 groupings, within each grouping there are several research foci. Groups provide a basis for staff to interact to develop and share research ideas, combine techniques and know-how, and provide a rich environment to enable world-class research.

Origins of Mind ('Origins'): Brown, Call, Carpenter, ***Cross***, Gomez, Hobaiter, Perrett*, ***Robbins***, ***Schweinfurth***, Seed, Zuberbuhler*

We are an internationally renowned cohort of researchers studying the comparative cognition of non-human animals, as well as developmental and evolutionary psychology in humans. Our research on primates is enabled by key collaborations with the best zoos and field stations in the world (e.g. Budongo, Uganda; Chimfunshi, Tai Forest, Ivory Coast, Zambia). We benefit from hosting our own field station at Edinburgh Zoo (Institution-Level Environment Statement, ILES, 4.3), we have a dedicated child psychology laboratory, as well as links to local schools and nurseries.

Publication highlights:

- 'Great apes anticipate that other individuals will act according to false beliefs'. Krupenye, et al 2016, Science. 354, 6308, p. 110-114 [PI Call] This is a *novel demonstration that apes predict the actions of an individual based on her false beliefs.*
- 'Social network analysis shows direct evidence for social transmission of tool use in wild chimpanzees'. Hobaiter, et al, 2014, PLoS Biology. 12, 9, 12 p., e1001960 [PI's Hobaiter & Zuberbuehler] F*irst ever evidence for the emergence of a new cultural behaviour in wild chimpanzees and of its spread in the group by social learning.*

Social and Group Processes ('Social'): Carpenter, ***Cross***, Dritschel, Mavor, *Pehrson*, Reicher, ***Robbins***, Sprengelmeyer, Tausch

Our work spans group processes (radicalisation, patriotism, collective action, leadership and social influence, social identity), morality and associated emotions, and social cognition and its links to psychopathology/emotional disorders. Our group benefits from a large 'social immersion' lab facility to conduct experimental work using groups of participants. We have extensive national and international collaborations which give us access to diverse populations (e.g. in India, Chile, China, Pacific Islands) and also special populations not available in our local rural environment (e.g. neurological disorders at Dundee, Ulm; mental health disorders, Yale). We also have excellent links with the UK and Scottish Governments which facilitate our research impact.

Publication highlights:

- 'Resistance in Repressive Contexts: A Comprehensive Test of Psychological Predictors'. Ayanian, Tausch, et al. (2020). *Journal of Personality and Social Psychology* [PI Tausch] *This is novel both conceptually and empirically, introducing the concept of disidentification, of considerable importance but hitherto ignored in the literature. It produces both a deeper understanding of the structure of disidentification and a validated measure.*
- 'Core disgust is attenuated by ingroup relations'. Reicher, et al, 2016, PNAS, USA. 113, 10, p. 2631-2635. [PI Reicher] *This is a significant advance, using the empirically measured emotion of disgust to show that emotion can be attenuated by membership of social group.*

Perception, Cognition and Action ('Cogact'): Ainge, Ales, Balslev, Bowman, *Donaldson*, Dritschel, Gomez, Harris*, Jentzsch, O'Connor, Otto, Perrett*, Vishwanath

Our research expertise delivers a system-level understanding of behaviour and cognition, linking topics from low-level perception, through cognitive processes, to behaviour and action, and species from drosophila, through mammals, to humans. We benefit from a suite of cognitive testing labs, facilities for EEG, TMS, eye tracking, immersive VR, and fMRI (at Ninewells Hospital, Dundee). A new investment in the development of mobile EEG has just got underway.

Publication highlights:

- 'From self to social cognition: Theory of Mind mechanisms and their relation to Executive Functioning'. Bradford, et al 2015, Cognition. 138, p. 21-34 [PIs Jentzsch, Gomez]. *Introduced a new experimental paradigm in Theory of Mind area to test perspective shifting. Task has proven very influential (> 100 citations), also extended to finding neural correlates of effect, reliability across cultures and neurologically diverse participant samples.*
- 'Flies and humans share a motion estimation strategy that exploits natural scene statistics'. Clark, et al, 2014, Nature Neuroscience. 17, 2, p. 296-303 [PI Ales] *This work bridged multiple experimental methods to demonstrate that both humans and fruit flies utilize a shared computational strategy for interpreting natural scene motion. Reveals a deeper understanding of how the natural environment shapes the way neural systems process information.*

Cellular and Behavioural Neuroscience ('Neuro'): Ainge, Bowman, Brown, Doherty, Li, Miles, *Pulver*, Sillar, Spencer, ***Zwart***

We study the neural circuits that control locomotion, the brain nuclei involved in spatial cognition, the effects of early life conditions and hormone exposure on the development of the brain and behaviour, and the molecular mechanisms involved in cell death and neurodegeneration. Our facilities include use of the St. Mary's Animal facility (rodents, birds), and state of the art labs for studying zebrafish and drosophila.

Publication highlights:

- 'Selective inhibition mediates the sequential recruitment of motor pools' Zwart, et al 2016, Neuron. 91, 4, p. 944 [PIs Zwart, Pulver]. *This study shows how movements are generated as a function of the modular organization of locomotor networks through segregation of inhibition, offering a potentially general mechanism to generate a motor pattern fundamental to behaviour.*

- 'Human iPSC-derived motoneurons harbouring TARDBP or C9ORF72 ALS mutations are dysfunctional despite maintaining viability'. Devlin, et al, 2015, Nature Communications. 6, 12 p., 5999. [PI Miles]. *This study revealed novel functional deficits in human motoneurons derived from stem cells from ALS/MND patients. These findings resolved controversy within the field regarding ALS/MND pathophysiology and highlighted ion channels as important new targets for future ALS/MND therapeutics."*

Our Global Reach

We work internationally to develop and nurture the best international collaborations and facilities. *Large scale collaboration highlights:*

- 'Contextual effects of positive intergroup contact on outgroup prejudice'. Christ, et al 2014, PNAS, 11, p. 3996-4000 [PI Tausch] *A multi-context, multi-level investigation that demonstrates that cross-group contact has a positive impact on outgroup attitudes even among those who have no direct contact experiences with the outgroup. Strong evidence across a variety of intergroup settings that contact effects reach beyond individual-level outgroup attitudes by shaping supportive social norms and thus reducing prejudice at the macro-level.*
- 'The evolution of self-control'. MacLean, et al 2014, PNAS. 111, 20, p. E2140- E2148 [PIs Call, Seed] *A unique, multi-lab, multi-country comparison of cognitive ability versus brain volume across 36 different species. These findings provide a significant first step toward quantifying the primate cognitive phenome and explaining the process of cognitive evolution.*
- 'Large-scale replication study reveals a limit on probabilistic prediction in language comprehension'. Nieuwland, et al, 2018, eLife. 7, 24 p., e33468 [PI Donaldson]. *This was a multi-lab replication study that raises serious questions about a seminal finding in language comprehension.*

Evidence of Achievement of REF2014 aims

Our aims as stated for REF2014 were three-fold: (1) strengthen and consolidate our research groupings, (2) enhance our research environment, and (3) develop our impact environment.

(1) Strengthen and consolidate our research groupings

New appointments have allowed us to both deepen and broaden our research expertise. We have experienced some PI turnover and retirement, allowing us to appoint 7 new PI's: 2 from fixed term to standard contracts, 1 Professor and 4 early career researchers. New appointments have been made across all 4 research groupings, to complement existing strengths and open up new and cutting-edge lines of research. Each research group has diversified its expertise and expanded its range of study species or population. For example, the *Origins* and *Social* groups have extended into significant cross-cultural studies of cognition and moral judgement, mental health and national identity, sex differences and decision making (Cross, Pehrson, Robbins, Schweinfurth). New appointments in the *Neuro* group have delivered novel cutting-edge techniques including optogenetics and computational connectomics, with potential for new connections with *CogAct* (Pulver, Zwart). A new Professorial appointment in *CogAct* has brought an exciting new expertise in mobile EEG (Donaldson). These appointments serve to enhance the research diversity of each group, and the School as a whole, ensuring our work remains at the leading edge of the disciplines.

(2) Enhance our research environment

Infrastructure In this REF period we have been awarded extra physical space for offices and labs (Bute Building) and received significant investment in research infrastructure (from both internal and external funding) totalling over £1M. This has allowed us to refurbish our child development 'ABC laboratory'. We continue to develop both the 'Living Links to Human Evolution Research Centre' and the unique 'Budongo Research Unit' at Edinburgh Zoo (ILES 4.3), providing facilities for studying non-human primate cognition. New wet lab facilities for *Neuro* include the creation of integrative labs for drosophila and zebrafish. Enhancements to the St Mary's Animal Unit have broadened facilities for rodent and avian research. We recently installed a 10Gb network connectivity for our data intensive research.

Collaboration & Interdisciplinarity We are proud of our inclusive and collaborative environment, which has delivered demonstrable added value to our research productivity. We collaborate across the School, within the University, as well as nationally and internationally (e.g. >60% of outputs in REF period have international co-authors). Local strategic prioritisation of cross-disciplinary engagement is further strengthened via Institutes and Centres that link minds from diverse disciplines. For example, our staff have been involved in the leadership of 3 cross-University initiatives: Institute for Behavioural and Brain Sciences (IBANS), the Centre for Biophotonics (bridging physics and biology) and the Centre for Social Learning and Cognitive Evolution (SLaCE). We have taken advantage of interdisciplinary PGR opportunities including St. Leonards Interdisciplinary PhD scholarships (ILES 3.3) and a new research initiative (SHARE) with the Royal Conservatoire of Music, Scotland. We have also been heavily involved in the setting up and leadership of the University's Centre for Higher Education Research (CHER).

(**3) Develop our Impact environment**
Since REF 2014 we have taken a structured approach to co-creating and maximising impact. The addition of a Director of Impact (DoI) to the School Management team (2018) has reinforced the strategic importance of the impact agenda. Impact is considered an essential element of research; thus, both are explored during annual individual meetings with academic staff (including temporary and Teaching-focused), with the Director of Research (DoR) and DoI. These meetings help identify and support impact at all stages from fledgling ideas through to current REF impact cases: from embedding impact in funding applications, applying for specific impact funding, to valuing impact in promotion and research leave applications. The importance of impact activity is also evident in appointments. In 2018 two early career academics were appointed to permanent contracts in part recognising their contributions in Impact and Knowledge Exchange (Cross, Ellis). To facilitate engagement networks, we include practitioners as speakers in our flagship weekly seminar program and we support science fairs and diverse outreach events to engage with a wide range of users from children and their parents to dementia sufferers and carers.

Our Future Aims
Our ethos is to play to our strengths by acting locally (in the School and wider University and community), but also to stretch ourselves intellectually by thinking globally, reaching out to collaborate across international boundaries. The School's current key strategic research aims are:

Diversify our research expertise: Our appointment strategy will maintain focus on excellence within groups, whilst providing breadth to stretch between and beyond our current strengths. In early 2021 we seek to replace a recent senior departure from *CogAct/Neuro* with a PI who will broaden our behavioural neuroscience interests. Additionally, a further appointment will be made in the growing field of behavioural economics and decision making, with the specific aim of spanning *CogAct/Origins* and linking with interests in the School of Economics and with a major University collaboration in behavioural economics with the University of Bonn. These appointments not only further consolidate our groupings, but also allow us to broaden our research base, facilitating further new and interdisciplinary research.

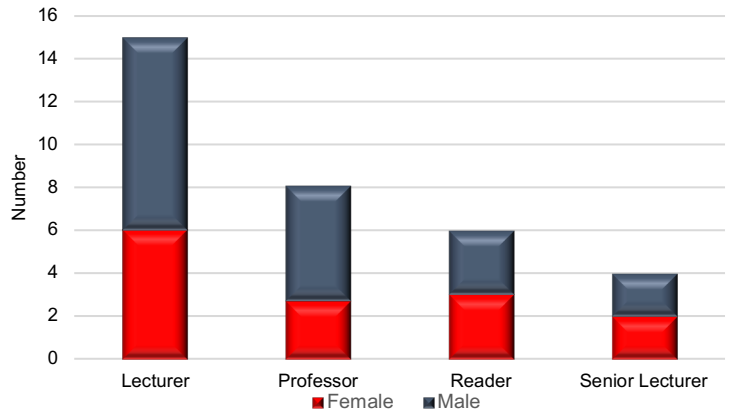
Investment in PIs: We will free up research time and capacity for research by appointing two new R&T academics (2021) and we have just appointed an additional standard-contract Education-focused lecturer (Autumn 2020). We have invested in multiple new types of shared microscopes that enable live imaging of neural activity and which will come online in 2021 (e.g. light sheet, spinning disc confocal, multi-photon). Additionally, we plan to further invest in infrastructure to deliver dedicated lab facilities for the new R&T appointments and high-end computing access for a range of colleagues across all groups. We are about to undertake major refurbishments that will enable development of mobile EEG human brain imaging, a significant new initiative for the School.

Enable inter- and multi-disciplinary research and impact: The University has recently (2018) placed inter-disciplinary research at the heart of its strategy (ILES section 2.5). We are at the forefront of this endeavour to realise 'Inter-disciplinary St Andrews', whose goal is to foster new collaborations that add value to expertise and interests across Schools. We will play a major part in the development of the ***Evolution, Behaviour and Environment*** priority (*CogAct, Origins, Neuro*). We also have PI's working on diverse projects within, and across, 4 of the other 5 themes, for example, ***Sustainability*** (*Origins*, *Neuro* and *Social*). We plan to develop engagement with impact in very early career psychologists and neuroscientists via new teaching modules for 4th year and postgraduate students.

Section 2. People

The School of Psychology and Neuroscience consists of a productive mixture of early career staff and more senior researchers and teachers, which provides a vibrant and inclusive research atmosphere (see figure 2, red/grey regions show women/men respectively). Over the REF period, we have been supported by 5 teaching focused academics and 14 professional services staff, who service both our research and teaching remits. The proportion of Professors in the School that are female has increased from 22% to 30% since REF 2014. We are mindful of equality, diversity and inclusion in all that we do and are proud to have been awarded Athena SWAN Silver in recognition of this in May 2018. Details of our EDI ethos and achievements are highlighted in a specific section below.

Figure 2: Ratio Male:Female Staff



Strategy for Strengthening Research with New Appointments

The University requests updates to our School Strategy each year, which enables us to be nimble in targeting recruitment in areas that enhance and extend our research. In this REF period we have recruited 7 new academic staff, to strengthen and maintain our 4 research groupings. We pride ourselves on growing talent, making 6/7 of our REF period appointments junior, with the exception being one senior position to maintain group strength in *Cogact* (replaces a retirement). We have made new appointments across all groups. Each person brings new expertise (Cross: sex differences in social behaviour; Donaldson: real-world cognitive neuroimaging; Pehrson: group processes and national identity; Pulver: *drosophila* locomotion, from genetics to animal behaviour; Robbins: development of fairness across cultures; Schweinfurth: origins of cooperation; Zwart: movement generation, from whole brain imaging to connectomics). The broader success of this recruitment strategy is evidenced by the progression of staff recruited during the previous REF period: 2 R&T academics have moved from temporary to standard contracts (Cross, Robbins), and 11 have progressed via promotion (2014-2019 rounds). We currently have plans for making 2 further appointments and are aiming to recruit people at the interfaces of groupings to facilitate further collaboration.

Supporting People to Enable Research and Impact

Supporting people is the heart of our approach in the School of Psychology and Neuroscience (P&N). We provide an environment that fosters our thriving academic culture, encourages creativity and provides time for thought, which is critical for the long-term sustainability of our research culture. This is evidenced through our management structures and specific support, including tailored activities for contract researchers (CR), postgraduate students and a specific EDI strategy.

Management Structures

Committees and representation: The P&N Research Committee promotes, manages and supports research and impact and is chaired by the Director of Research (DoR). Membership includes the Director of Impact (DoI), representatives from each research grouping, School administration, contract research staff, and research postgraduates. The DoR and DoI both sit on the School Management Group and attend regular University Research and Impact meetings, chaired by the Vice-Principal for Research.

Workload model (WLM): Our School ethos is that all R&T and Education-focused academics have time to engage in research, impact and scholarship. To enable this, the WLM is used to deliver an equitable teaching and administration workload, with probationary staff carrying out a half-load. The WLM quantifies and aims to balance i) Teaching, ii) Administration, and iii) PhD Supervision, with the purpose of giving staff equal opportunity to use the remainder of their time for research, impact and scholarship. The WLM takes into account individual circumstances, such as secondments, disabilities and partial FTE, and specific load changes, including Covid-19 teaching arrangements. In 2021 we are developing an online interface with WLM to enhance transparency.

Research/Impact Leave and seasonal research: PIs are encouraged to apply to the Head of School for a one-semester sabbatical per eight semesters of regular teaching and administration. This leave can allow staff to focus on research or impact activities. The School has introduced a new, transparent process for applying for research/impact leave, which has been shared with other science Schools as an example of University best practice. We actively encourage staff to apply for funded research 'leave' by way of individual fellowships (e.g. Spencer and Zwart awarded Royal Society Edinburgh Fellowships for a year's research leave; Ainge awarded Durham Institute of Advanced Study Fellowship). In addition, we offer flexibility for staff whose research requires specific periods in the field, allowing them to work remotely for several months a year so that they can better conduct seasonal research and supervise fieldwork.

Specific Support for Research

Financial support: The School invests around £50k per year in supporting PIs via a research fund allocation for basic research support. Each PI is awarded a base rate, with enhancement for each PhD student or RA supervised (average in 2019-20 was £1.7k). This covers baseline consumables and/or conference travel for the PI's group. The HoS additionally holds a contingency fund for exceptional items (e.g. equipment breakdown, critical consumables). The School also core funds participant reimbursement for behavioural and pilot fMRI studies (including licences for Gorilla, Qualtrics and Pavlovia online research platforms); supports core consumables for neuroscience (e.g. autoclave, microscope maintenance), and a dedicated neuroscience laboratory technician. Both the School and University encourage undergraduate vacation scholars by providing internal funding and supporting applications for external scholarship funding (e.g. Laidlaw, Nuffield).

Research and impact events: Our Friday Seminar Series includes talks from national and international researchers and discipline practitioners. Lunch for postgrads and ECRs is provided at each of these to facilitate interaction with speakers. Under Covid-19 restrictions we instead host a Teams meeting for ECR to discuss careers with each speaker. The annual Jeeves Lecture (named after the School's founder, Prof. Malcolm Jeeves) is given by a world-leading researcher. The School also runs weekly postgraduate talks. In addition, research groupings organise journal clubs (e.g. Hormones and Behaviour, ABC lab, Perception, Spinal Cord and Movement). Beyond the School, we are actively involved in inter- and multi-disciplinary Institutes - the Institute for Behavioural and Neural Sciences (IBANS), the interdisciplinary Behavioural Discussion Group (co-hosted with Biology), and the Centre for Biophotonics (co-hosted with Chemistry, Biology, Physics).

Research Culture: One member of our staff (Harris) is a member of the University's new Research Culture Group, aimed at developing policy and practise to improve research culture

across all disciplines. She has also recently won inter-disciplinary University funding to conduct a staff survey on current Research Culture that will directly feed into this group.

Interaction with University Resources: The University allocates us a dedicated 'Business Development Manager', Prabs Dehal, to advise on funding opportunities. As well as Prabs sending us regular information and updates and delivering grant writing training, we invite her to run monthly 'research clinics' in the School to meet individual PIs, CRs and PGRs. The School holds regular 'lunchtime update' meetings. We regularly invite expert administrators from around the University to update us on the latest developments and support (e.g. Open Data, Risk Assessments, Attracting Funding and Best Practise for PhD Supervision).

Bespoke training courses: Through the annual academic review process, staff are encouraged to develop skills by taking courses offered at the University's Centre for Academic, Professional and Organisational Development (CEED). We have dedicated budgets for professional services staff and contract researcher external training.

Dedicated support for Contract researchers (CR): All CR staff have an Annual Review and Development meeting with their line manager and are encouraged to engage with appropriate Centre for Educational Enhancement & Development (CEED) courses, including the 'Passport to Research Futures' programme. CRs are fully integrated into the School's life, they have representation on the Research Committee and the School Council. Regular networking lunch events are organised, where one (or more) PI's discuss life as an academic (example topics: work-life balance, social media, what is REF?). If CR staff have funding gaps, the School is able to access University bridging funds (for up to six months) to maintain salary and contract continuity. We support early career scientists by encouraging fellowship and grant applications. Recent grant successes include Marie Curie Research Fellowships, a Royal Society Newton International Fellowship, Natural Sciences and Engineering Research Council Canada (NSERC) funding, two Carnegie Research Incentive Grants, 2 H2020 MSCA research fellowships, a Santander small grant award and one grant from the Swiss National Science Foundation.

Mentoring schemes: Development of an individual scientist requires insider-knowledge on how and where to focus one's efforts. To guide staff and broaden equality and diversity of opportunity, we encourage mentoring (formal and informal) at all career levels. Probationary academic staff members are assigned a local mentor. We encourage participation in a variety of mentoring schemes offered at different career levels: (a) cross-institutional scheme for early career researchers (including CR and ECR PI's) (b) mid-career Aurora leadership scheme for women and (c) Elizabeth Garrett scheme for senior women. Many staff within the School participate as both mentors and mentees (feedback and monitoring is via Annual Review meetings).

Facilitating Interdisciplinarity: We engage with a number of cross-School collaborations (e.g. with *Computer Science* on human-computer interaction, *Biology* on animal behaviour, Economics on decision making, *Medicine* on medical education and health psychology, *Music* on cross-modal perception and psychoacoustics). Many of these collaborations have been initiated via cross-School seminars and journal clubs. The University-wide St. Leonards Graduate School encourages interdisciplinary work via PhD funding, as does the Scottish Graduate School for Social Sciences (has led to productive collaborations with the Schools of English, Physics, and Medicine). Funding support for inter-disciplinary projects has been obtained from some of the above institutes. 29% of our 2019-20 PhD students are supervised across subfields within the School or across Schools. For example, Cross hosts a PhD student (Whitefield) to work on thematic analyses of domestic violence co-supervised by Raychaudhuri (English); Donaldson and P Miles host an ESRC student (Porter) to work on enhancing teaching in schools (collaboration with Education and Computer Science).

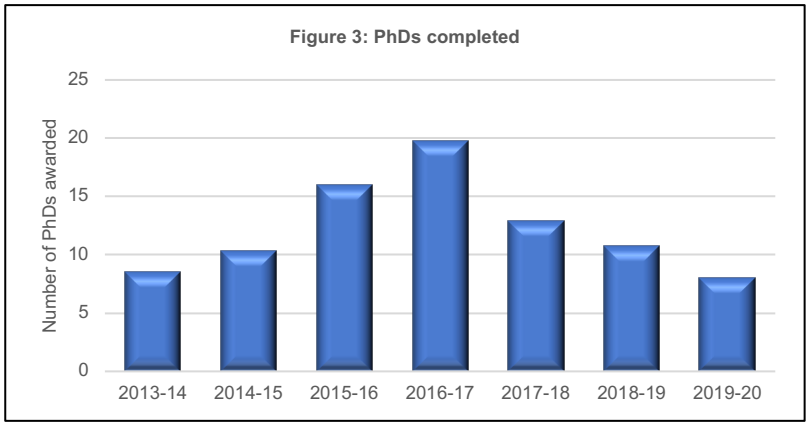
Covid-19 adaptation: most items above were pre-Covid-19. During Covid-19 restrictions we have continued key meetings virtually (Management Group, Research Committee, informal daily Staff Coffee and weekly Staff Info) and set up several working groups to address key issues: (1)

supporting postgraduates, (2) developing new research tools to enable online human research, (3) developing protocols, risk assessments and ethics procedures to restart human research, (4) building re-opening as soon as University allowed for essential (non-human facing) research, (5) re-opening of zoo-based field site, (6) School Friday seminars and Psycholoquia moved online for 2020, (7) Dehal has run several virtual workshops for early career researchers to develop their grant writing skills.

Research Students

Postgraduate student numbers: Our current cohort of 71 research postgraduates (2020-21 academic year: 65 PhD, 5 masters by research) is diverse: 75% women, 20 countries of origin (40% non-EU), and were admitted with excellent first degrees and masters qualifications. Competition for funded places is very strong. Numbers of students registered on both these degree routes have steadily risen over the current REF period. Our PhD completion numbers are holding steady over the REF period (see figure 3, 19-20 is part-year).

Figure 3: PhDs completed



Supervision structures and progression: Research students form a vital part of our academic community, with representation on the School Council, Research Committee, EDI Committee and Staff-Student Consultative Committee. All students are allocated a Principal Supervisor, a Second Supervisor (primarily a pastoral role) and some students have science-focused Co-Supervisors. Student progress is monitored via reports at the end of the 1st year and a viva is undertaken at this point to determine progression to the second year by the Second Supervisor and another PI with relevant experience. Written annual progress reports from the student and supervisors are assessed by the Postgraduate Committee, chaired by the Director of Postgraduates. All information is made available for students in the School's Postgraduate Handbook (subsequently adopted by other Schools, e.g. Physics, as a 'best practise' approach) and students are able to access their own annual reports and discuss these with their supervisors. Additional pastoral support is provided by our School Wellbeing Officer, who is available for individual meetings with postgraduate students.

Student training and skill development: We provide full access to a comprehensive Postgraduate Training Programme consisting of subject-specific skills, professional skills courses and other training events. Each year postgraduates give a 30-minute 'Psycholoquium' talk and produce a poster for the annual Postgraduate Research Session, an event open to all members of the School. Specific training programmes for individual students are agreed annually via a comprehensive Training Needs Analysis with supervisors, and students keep a record of all their training activities in a Postgraduate Logbook. Postgraduates also participate in the student-run Psychological Society and the Neuroscience Society who host both research and career development events.

Facilities: All postgraduate research students are provided with a desk and computer, and supervisors receive £1k per student per annum to support basic expenses and conference attendance. The School's Research Student Travel Fund provides support (up to £1k over 3 years) for attendance at international conferences.

Beyond the School: The University GRADSkills programme includes training sessions on topics such as managing a PhD, communication with your supervisor, thesis writing and interview skills. Our students are encouraged to engage with this and other external training programmes, utilising the Logbook (see above) to advise and monitor on progress. Supervisors

also encourage students to take advantage of the Student Support Service, Mathematics Support Centre, and the Careers Centre. Our active involvement in UKRI DTPs (BBSRC EASTBio, NERC SUPER, ESRC Scottish Graduate School for Social Sciences) affords many PGRs access to discipline-specific training. Our PhD students also regularly present at annual conferences, e.g., Scottish Neuroscience Group, Scottish Vision Group, Scottish Primate Group, IBANS ECR Symposium, and regularly receive external funding to present at international conferences.

Equal Opportunities and Diversity

The School is committed to creating an inclusive environment that supports equality of opportunity and fairness for all.

University-level and national-level actions: Our staff have made significant contributions at University and national levels; for example:

- a former staff member (V. Brown) chaired the University's Athena SWAN Self-Assessment Team in her role as Vice-Principal for Enterprise and Engagement (2015-16),
- a staff member (Harris) founded (2018) and led (2018-2020) the Senior Women in St. Andrews network, to share knowledge and best practise around gender related issues.
- the School's Equality, Diversity and Inclusion (EDI) Officer (G. Brown) was a member of the University's Statistical Analysis working group for its Athena SWAN Bronze award (2018),
- the EDI Officer has been appointed as the University's first Science & Medicine EDI Faculty Lead (2020-22) and sits on the University's Central EDI Committee,
- the University made changes to the Academic Promotions processes in response to our lobbying, and has adopted The School's revised Academic Review and Development Form,
- our gender bias research has been presented to the Scottish Government (Cross), and
- our staff engage annually in widening access programmes, including First Chances, Lift-off 2 Success and REACH programmes and Sutton Trust Summer Schools.

School-level actions: The School EDI Officer is a member of Management Group and chairs the School's EDI Committee, which consists of academic/professional staff and UG/PG student representatives. This Committee delivers relevant actions and initiatives, for example:

- an annual School 'Wellbeing Day' with events for UGs, PGs and staff,
- an 'Out Thinkers' event (2019), in association with Pride in STEM, which involved a set of research talks LGBT+ STEM researchers from our staff and PG community,
- a School round-table discussion on Racism in Academia and a resulting action plan,
- a Silver Athena SWAN award (2018), with key actions including the transfer of three fixed-term, female lecturers onto standard contracts, gender parity among seminar speakers, introduction of 'core meeting hours', and a 'Planning for Leave' checklist.

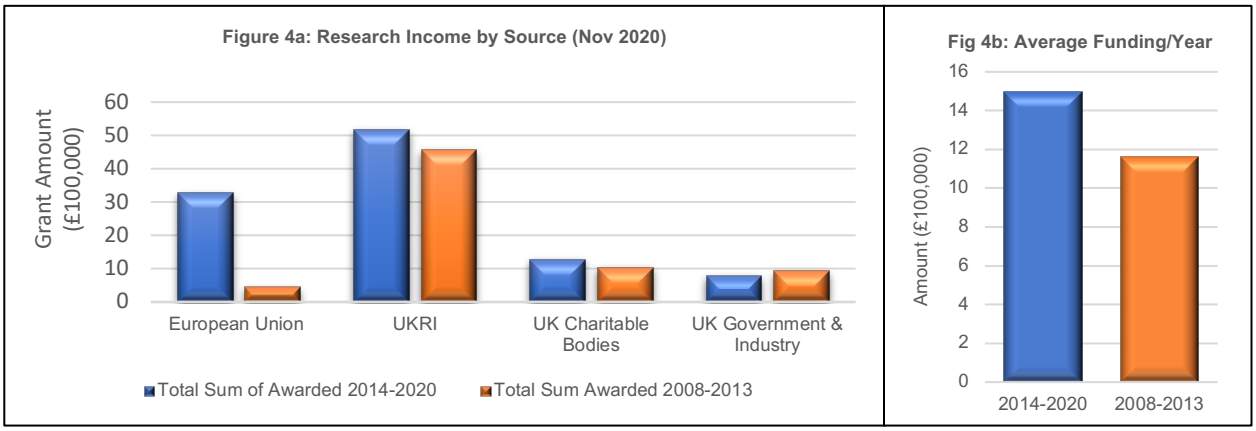
REF-related practices: The School has followed the University's REF2021 Code of Practice, our HoS, DoR, Deputy DoR and EDI Officer undertook 'E&D in the REF' training. The School panel that assessed REF outputs was gender-balanced, the gender balance of scored outputs was monitored throughout (both locally, and centrally). As in REF2014, the gender balance of scored research outputs was monitored during the scoring process and data interrogated to check for bias in choice of outputs for submission. No bias was found.

Section 3. Income, infrastructure and facilities

The School's funding strategy is to attract support from a diverse range of sources and has broadened that diversity since the last REF (see figure 4). Some research across our broad research remit is more expensive than that in other research areas. We support staff in applying for the funds that they require, no matter how small, and we do not measure success or set goals in purely financial terms. Facilitated by University level support from Business Development, the DoR facilitates staff engagement with local expertise in supporting application to particular funders.

Major Research Income

During the REF period, the School has been awarded around £10M in competitive grant funding from a broad range of sources. We have improved overall compared to the last REF period. Figure 4 compares our research income in this REF period (2014-2020), with comparable years in the previous period (2008-2013), based on University financial year (e.g. 2014 is equivalent to August 14 – July 15).



Although the School has not grown in terms of research FTE since REF 2014, our total grant income is considerably higher (~£10M) than in the previous period (£8.6M). Notably, our EU funding has increased dramatically. This funding includes 3 highly prestigious ERC-funded grants (Investigator and Starter grants to Call, Hobaiter, Seed). Our UKRI funding maps to our diverse research portfolio: we have secured funds from the EPSRC, ESRC, NERC and BBSRC. We have improved, compared to previous performance, from UKRI and also on funding from UK charities (including the Royal Society of Edinburgh, Royal Society of London, Wellcome Trust, Cunningham Trust, Academy of Medical Sciences, Alzheimer's UK, and the Leverhulme Trust). We have also received impact-related research funding from the University's EPSRC Pathways to Impact Fund, Knowledge Exchange program and Wellcome Trust ISSF fund.

Postgraduate Students

During the REF period the School has received PhD studentship funding from a wide range of sources. *UK and European core funding:* EASTBio BBSRC DTP, Scottish Graduate School of Social Science ESRC DTC, University EPSRC DTG, NERC, ERC. *Charities:* AD Links Foundation, Cunningham Trust, MND Association, SPRINT-MND/MS. *International:* BECAS Chile, Indonesian Endowment Fund for Education, JASSO Student Exchange Support Programme, Japan, DAAD Germany. *University:* Jonathan and Hazel Sparey Scholarship, China Scholarship Council, St Leonards Graduate School: International Doctoral Fee, Interdisciplinary, European Inter-University, World Class doctoral scholarships. *Industry:* Santander 600 Postgraduate Research Scholarship; British Trust for Ornithology, Boehringer Ingelheim, Cairn Instruments, Kaunas Industrial Water Supply. When possible, the School directly funds PhD studentships each year from its annual budget. Funding for MPhil students is obtained via close links with Emory University in the USA, and through the University-led Bobby Jones Fellowship scheme. Around 18% of our PhD students are self-funded.

Research Infrastructure and Facilities

The School provides and supports a wide range of research facilities. During the REF period, £1M investment has been made in our research infrastructure. Each of these facilities allows research groups to deliver world-class research output. In addition, some provide a focus for significant non-academic interaction with stakeholders such as the public, NGOs and governmental agencies (see below for details).

1) Experimental neuroscience facilities (supporting *Neuro* and *Cogact*). The University hosts a secure animal facility, which supports research on rodents, birds, amphibians, and fish (in a dedicated facility at the new Scottish Oceans Institute, ILES 4.2). The main facility comprises animal holding rooms, an outdoor aviary facility, a surgical suite, and behavioural testing rooms.

It is staffed by a dedicated manager and 6 animal technicians. During the REF period over £270k has been invested by the University to boost these cross-School facilities. The School also boasts state-of-the-art wet-lab and histology facilities, equipped to undertake up-to-date molecular and protein analyses. A University investment of £350k has created two integrative laboratories equipped with specialist molecular and imaging equipment, which expand our species range and live imaging techniques significantly (Drosophila, zebra fish). These augment an existing Imaging Suite, housing advanced multi-photon and fluorescent microscopes.

2) Human behavioural and imaging facilities (supporting *Cogact* and *Social*). Our researchers conduct fMRI and simultaneous EEG-fMRI experiments using facilities at Ninewells Hospital, Dundee, through the cross-university Scottish Imaging Network: A Platform for Scientific Excellence (SINAPSE) pooling initiative. The School also hosts dedicated EEG laboratories, and a £30k Trans-cranial magnetic stimulation (TMS) system. Specialised equipment for vision research includes stereoscopic displays, eye-movement trackers, limb-trackers, a 3-D scanner, hyperspectral camera, spectrophotometers and thermal imagers, and computing facilities with software for studying face perception. We have individual and group testing areas, including computer clusters and a Social Immersion Laboratory. The human experimental laboratories have undergone refurbishment at a total cost of over £30k during the REF period.

3) Primate behavioural observation facilities (supporting *Origins*): The 'Living Links to Human Evolution Research Centre', opened in 2008. This is a University of St Andrews primate research centre, housed in Edinburgh Zoo. Living Links was created through a £1.6M research grant from the Scottish Funding Council and provides excellent facilities for studying primate behaviour and cognition. During the REF period University funds have also significantly invested in another resource at the Zoo, the Budongo Research Unit, facilitating research on chimpanzees (£500k to Living Links/Budongo, ILES 4.3). We also study primate behaviour at the Keeling Center, Texas and Max Planck Institute for Evolutionary Anthropology, Leipzig.

4) Developmental Psychology facilities (supporting *Origins* and *Social*): The School houses a dedicated Child Development laboratory (investment £78k). The ABC (St Andrews Baby and Child) Lab is supported by a School-funded lab manager and is utilised by 6 PIs. The facility enables researchers to study a wide range of topics in child social and cognitive development, including prosocial behaviour, tool use, episodic memory development and theory of mind. Due to its close links with the community through participant recruitment, the lab also hosts several public engagement activities throughout the year. Research in this area is also carried out at sites such as the Dundee Science Centre, St. Andrews Aquarium and several local schools and nurseries.

5) Field work networks and facilities (all groups): Our fieldwork site portfolio is diverse and spans developmental psychology, primate behaviour and experimental neuroscience. The School offers flexible working opportunities for PI's who need season-specific access to field sites. Research on primates takes place in: Chimfunshi chimpanzee sanctuary, Zambia (the oldest and largest sanctuary of its kind in the world); Budongo Conservation Field Station, Uganda (14 year-long School commitment at this site); Bugoma Primate Conservation Project, Uganda; Bwindi Mountain gorilla project, Uganda; Bossou-Nimba Chimpanzee research project, Guinea. Our developmental psychology field work is centred in schools and educational institutions in Samoa, including sites on the islands of Upolu and Savai'i. We utilise seabird breeding sites in the UK (Isle of May National Nature Reserve; Fidra Island, Firth of Forth) and in Belgium and the Netherlands.

6) School professional services support: Our research in the REF period has been facilitated by a team of 15 Professional Services staff: a School Manager, an IT Manager, 4 mechatronics/mechanical engineering technicians, 1 laboratory technician, 2 ITC technicians, and 1 software developer. The School has also been supported by 5 members of administrative professional staff. Support offered by the School Workshop is wide ranging, including the design and development of software applications, digital and analogue electronic and microcontroller-based equipment and bespoke and highly specialised hardware and software for projects used

in research, teaching and public engagement. The administrative team has a varied and expansive remit including: support for teaching programmes, research administration for PGR students, research and impact project management for staff, financial planning and funding administration for staff and students.

7) Ethics, Integrity and Culture: The School's Ethics Committee approves ethical applications for human experimental and non-licenced animal research, overseen and supported by the University Teaching and Research Ethics Committee and the Animal Welfare and Ethics Committee. The School influences University level policy through staff involvement on University level committees that work to enhance and streamline ethical review and policy. Licenced animal research takes place in the separately managed St. Mary's Animal Unit. The DoR contributes to development of University policy on research integrity and research culture, and School Research Committee are responsible for developing best practise in these rapidly changing areas. DoR will sit on University's new Research Culture Group in 2021.

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

As a School, we have an outward facing research ethos and a global reach. A key strand of our research strategy is to maintain international links and develop new ones, to enable world-class research. We use a light touch, via annual staff review, to encourage international collaboration in research and impact. This approach fosters drive, from the bottom-up, to find the very best connections and networks. Using this approach, we have a large number of ongoing international collaborations. Our researcher and PGR community are highly international (e.g., 40% of our current PGR are from outside the UK or EU). Much of our research funding involves international collaborators, and many of our outputs have international authors (60% in REF period). Highlights of activity include: (i) a long-term collaboration with the Max-Planck Institute for Evolutionary Anthropology in Leipzig, Germany on topics from life-history to social cognition in great apes. (Hobaiter), (ii) a collaboration with 3 universities in India to conduct a series of unique studies on crowds and identity at the Magh Mela religious festival (Reicher), (iii) collaboration with Jenelia Research Campus, one of the top biomedical science institutes in the world, bringing novel technical tools to neuroscience research (Pulver, Zwart).

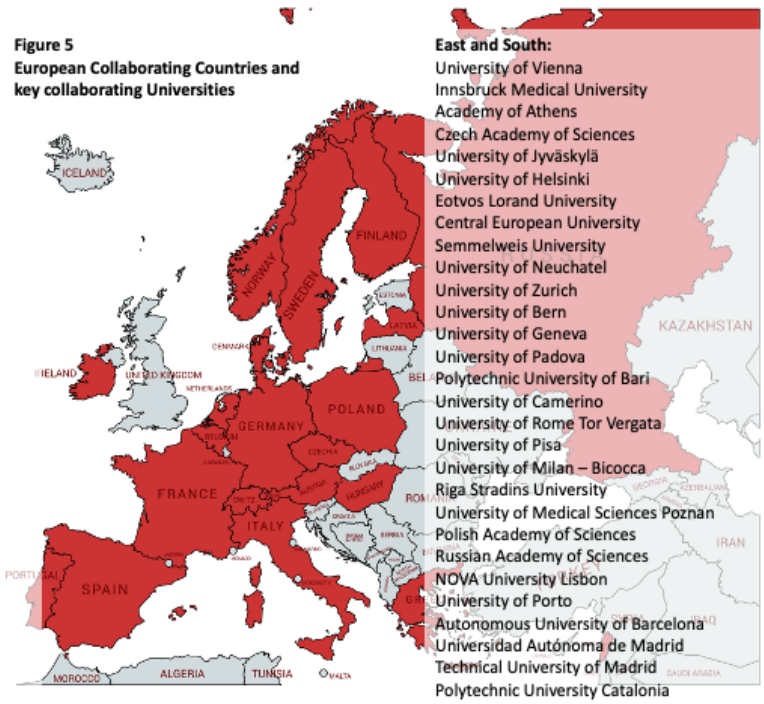
Research Collaborations Networks and Partnerships

International Research Collaborations: In the REF period, we have produced outputs with collaborators from over 500 different institutions, from 46 countries. The graphs and tables in Figures 5 (Europe) and 6 (rest of the world) highlight the countries and some of our major collaborating universities.

Local and National Collaboration: The School's research is embedded within several active research centres and institutes within the University and nationally. Our broad scope allows us to contribute to 5/6 of the University's collaborative research priority areas (a: *Evolution, Behaviour*

and Environment, b: Cultural Understanding, c: Sustainability, d: Health, Infectious Disease and Wellbeing, e: Peace, Conflict and Security ILES, 2.5*).*

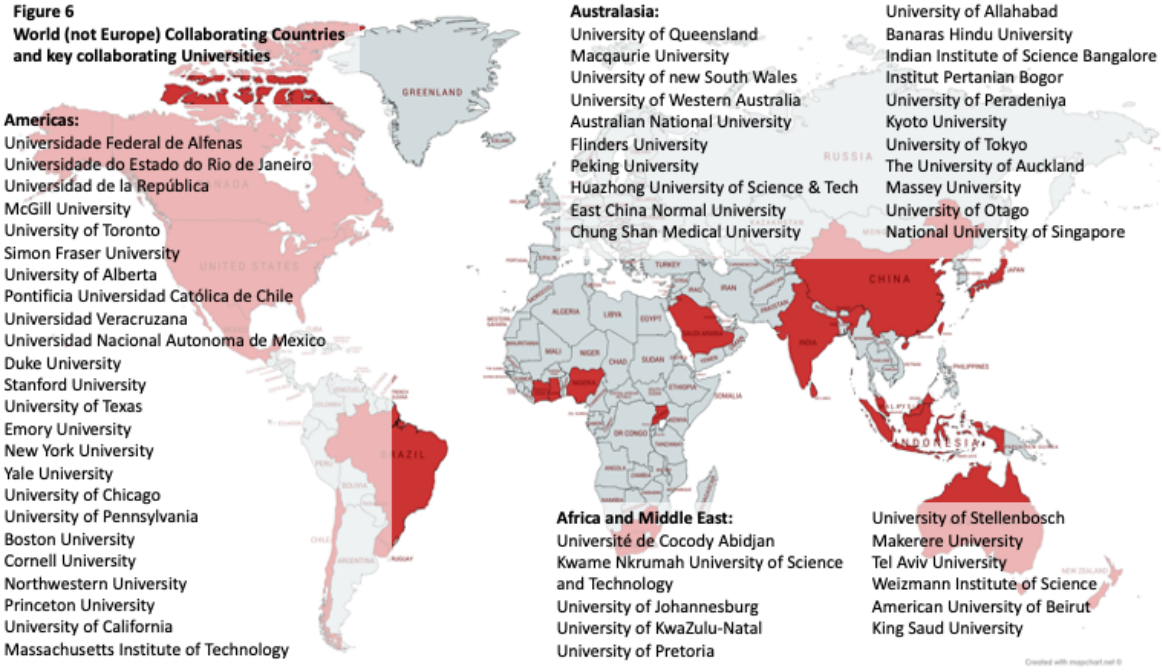
Figure 5
European Collaborating Countries and key collaborating Universities



North and West:
University of Antwerp
Université Catholique de Louvain
Université Libre de Bruxelles
University of Copenhagen
Aarhus University
École Normale Supérieure, Paris
Université Paris-Saclay
Sorbonne Université
Université de Rennes 1
Université de Toulouse
Université de Strasbourg
MPI Evolutionary Anthropology
MPI Human & Brain Sciences
Leipzig University
University of Tübingen
University of Göttingen
Humboldt University of Berlin
Heidelberg University
University of Cologne
Technische Universität Dresden
University College Dublin
University of Amsterdam
Leiden University
Radboud University Nijmegen
Utrecht University
University of Bergen
University of Oslo
Karolinska Institutet
Lund University

East and South:
University of Vienna
Innsbruck Medical University
Academy of Athens
Czech Academy of Sciences
University of Jyväskylä
University of Helsinki
Eotvos Lorand University
Central European University
Semmelweis University
University of Neuchatel
University of Zurich
University of Bern
University of Geneva
University of Padova
Polytechnic University of Bari
University of Camerino
University of Rome Tor Vergata
University of Pisa
University of Milan – Bicocca
Riga Stradins University
University of Medical Sciences Poznan
Polish Academy of Sciences
Russian Academy of Sciences
NOVA University Lisbon
University of Porto
Autonomous University of Barcelona
Universidad Autónoma de Madrid
Technical University of Madrid
Polytechnic University Catalonia

Figure 6
World (not Europe) Collaborating Countries and key collaborating Universities



Americas:
Universidade Federal de Alfenas
Universidade do Estado do Rio de Janeiro
Universidad de la República
McGill University
University of Toronto
Simon Fraser University
University of Alberta
Pontificia Universidad Católica de Chile
Universidad Veracruzana
Universidad Nacional Autonoma de Mexico
Duke University
Stanford University
University of Texas
Emory University
New York University
Yale University
University of Chicago
University of Pennsylvania
Boston University
Cornell University
Northwestern University
Princeton University
University of California
Massachusetts Institute of Technology

Australasia:
University of Queensland
Macqaurie University
University of new South Wales
University of Western Australia
Australian National University
Flinders University
Peking University
Huazhong University of Science & Tech
East China Normal University
Chung Shan Medical University
University of Allahabad
Banaras Hindu University
Indian Institute of Science Bangalore
Institut Pertanian Bogor
University of Peradeniya
Kyoto University
University of Tokyo
The University of Auckland
Massey University
University of Otago
National University of Singapore

Africa and Middle East:
Université de Cocody Abidjan
Kwame Nkrumah University of Science and Technology
University of Johannesburg
University of KwaZulu-Natal
University of Pretoria
University of Stellenbosch
Makerere University
Tel Aviv University
Weizmann Institute of Science
American University of Beirut
King Saud University

We also actively participate in a number of other Research Centres including:
The Institute of Behavioural and Neural Sciences (IBANS), a cross-disciplinary centre, which we co-direct, that brings together 80 PIs across Psychology & Neuroscience, Biology, Medicine, Chemistry, Computer Science, Economics, Maths & Statistics and Physics, who share an interest in the neural underpinning of behaviour. IBANS pump primes collaborative partnerships, provides ECR training and co-ordinates events to stimulate interdisciplinary research.

The Centre for Social Learning and Cognitive Evolution brings together PIs from Psychology & Neuroscience with those from Biology, who share common interests in the evolution of cognition and culture. This has facilitated significant cross-school funding (e.g. Templeton Foundation, BBSRC).
The Centre for Biophotonics promotes interdisciplinary research and training at the interface between advanced optical imaging, photonics and biomedical sciences. It builds on existing strengths in the development and application of light-based technologies (Physics) to investigate biological processes at molecular, cellular and tissue level.
The St Andrews Bioinformatics Unit (StABU) provides cross-University support to large sequence analysis and functional genomics projects. The Unit works with researchers in running analyses and providing training as well as supporting in grant applications and publication writing.
The Scottish Universities Life Science Alliance (SULSA) is a strategic alliance between eleven Scottish Universities whose aim is to advance Scotland's research and innovation in the life sciences. The Scientific Advisor for Development and Regulation theme is based within the School (Spencer).
The Scottish Imaging Network a Platform for Scientific Excellence (SINAPSE): is a world-class consortium of 6 Scottish Universities, providing a collaborative network for strategic research development in human brain imaging. We chaired the annual conference for this group in 2020 (Donaldson).
Scottish Primate Research Group (SPRG) provides a forum for primate researchers and has led to joint research ventures, such as grants, publications and PhD supervision.

Interdisciplinary research
The School boasts a truly inter-disciplinary environment (ILES, 2.5). We aspire for our researchers to achieve real strength and depth in their areas of expertise, as well as a real willingness to reach out and work broadly to ensure collaborations in areas where we might have less depth. This combination of breadth and depth fosters a fertile exchange of ideas. Our ability to do this is facilitated by our School structure, our world class facilities and the collegiality of staff. In addition, we undertake research with academics across a variety of disciplines beyond the School, including optometry and sports sciences (BBSRC), clinical medicine (NC3Rs, Pfizer Neusentis and Grünenthal), biomedical science (Alzheimer's Research UK), philosophy (AHRC), biology (Templeton Foundation, BBSRC), education, theology (Leverhulme Trust) and ecology (Leverhulme Trust, Royal Society of Edinburgh). Our ability to undertake such integrative work has attracted visiting scholars from a range of disciplines. During the REF period the School has also hosted over 30 scholars for research visits from Australia, Austria, China, Denmark, France, Germany, Hungary, Italy, Japan, Netherlands, Norway, Poland, Portugal, South Africa, Switzerland, Turkey, UK and USA. Visits have resulted in ongoing collaboration and publications (e.g. Acar visited and published with *Social*, Zhang with *Cogact*), and with new training initiatives (e.g. Johnson visited *Neuro*, and initiated program for MRes Neuroscience students to submit and publish papers in Journal of Neuro. Undergrad Ed).

Contributions to the research community
Researchers from all four groups contribute at the highest level to the research base, as well as to service to the research community. Contribution highlights are detailed by category and research grouping below.

1) Prizes, honours and fellowships
Staff at all career levels have excelled in this category. Highlights include fellowships of the Royal Society of Edinburgh (RSE) Young Academy of Scotland and 3 British Academy Fellowship holders.

origins	APA Distinguished Scientific Award for Early Career Contribution to Psychology 2014 (Seed), UKRI Role Model in Environment 2019 (Hobaiter), British Academy Fellowship 2019 (Call), Royal Society of Edinburgh Fellowship 2016 (Call), Fellow, Cognitive Science Society 2015 (Call), RSE Young Academy of Scotland 2018 (Seed), Aurora Leadership Fellow, Leadership Foundation for Higher

	Education 2016 (Robbins), National Institutes of Health (NIH) IMSD Fellow 2016 (Robbins).
neuro	Paulo Gontijo Award, International Symposium on ALS/MND 2015 (Miles), Macknight Educator Award 2016 (Pulver), RSE Sabbatical Research Grants, now starting 2021 (Spencer, Zwart), Leverhulme Senior Research Fellowship 2020 (Spencer)
social	Harold Lasswell prize, International Society for Political Psychology 2018 (Reicher), British Academy Fellowship 2017 (Reicher), Public Engagement with Research Award 2018 (Cross) Fellow, Royal Society of Edinburgh 2004 (Reicher), Canadian Institute for Advanced Research (CIFAR) Fellowship 2019 (Reicher), 2020 Wegner Prize for Theoretical Innovation: Society for Personality and Social Psychology (Reicher).
cogact	Chercheur Invité Visiting Fellowship, Grenoble University 2018 (O'Connor), Institute of Advanced Study (Durham Univ) Fellowship, 2020 – postponed until 21 (Ainge). British Academy Fellowship (Perrett), Royal Society of Edinburgh Fellowship (Perrett).

2) Service to learned societies and funding bodies

Academics from all groups give their time to organise and run major international societies (e.g. International Primate Society, European Society of Philosophy and Psychology) and take part in funding panels (e.g. BBSRC, Fondation Fyssen, Research Council of Norway, DFG Germany).

origins	Vice-President of the International Primatological Society 2016 (Hobaiter), Vice-President of the European Human Behaviour & Evolution Association 2012-15 (Brown), President of the European Society of Philosophy and Psychology 2014-17 (Gomez), Fellows Committee Cognitive Science Society 2016 (Call), Member of Scientific Council, Fondation Fyssen 2011-18 (Call)
neuro	Animal Welfare Research Network member 2018 (Spencer), BBSRC core panel member (Miles, Spencer), Alzheimer's Society Grant Review Panel 2018 (Doherty), MNDA Biomedical Research Advisory Panel 2016 (Miles), Chair of Neuroscience Panel, Research Council of Norway 2017 (Sillar), Royal Society Newton International Fellowship Panel 2013-18 (Li, Pulver)
social	ESRC program on Governance after Brexit (Reicher), RSE Crucible selection panel (Reicher), RSE Fellows Selection Panel (Reicher)
cogact	Experimental Psychology Society Committee Member 2013-15 (Jentzsch), Member of the Applied Vision Association Committee 2011-15 (Harris), BBSRC core panel member (Harris), BBSRC pool panel member (Otto), ESRC funding college (Harris), EPSRC funding college (Harris), UKRI Future Leaders Fellowship Peer Review College 2018 (Harris), Carnegie Trust Research Panel 2017-20 (Harris), DFG grant review panel, Germany 2016-18 (Jentzsch), REF 2021 subpanel 4 panel member (Donaldson), Executive Committee Member, Association of Heads of Psychology Department (Donaldson from 2020, previously Chair).

3) Service to conference organisation and journals

We have organised a number of major conferences in the REF period (highlights include European Society for Philosophy and Psychology, International Symposium on ALS/MND), and our staff serve on editorial boards at major journals (a highlight is Editor in Chief, Journal of Comparative Psychology).

origins	European Society for Philosophy and Psychology Conference, St. Andrews,2016 (Gomez); Senior editorial: Editor in Chief, Journal of Comparative Psychology (Call); Editorial boards: Animal Cognition (Call), Child Development Perspectives (Carpenter), Ethology (Brown), Frontiers of Comparative Psychology (Call), International Journal of Comparative Psychology (Call), Hormones and Behaviour (Brown), International Journal of Primatology (Hobaiter), Learning and Behaviour (Call), Perspectives in Psychological Science (Call).

neuro	Alzheimer's Society Network Meeting 2014 (Doherty), 29th International Symposium on ALS/MND, Glasgow 2018, Alzheimer's Research UK Conference, Aberdeen 2017 (Doherty), Federation of European Neuroscience (FENS) Forum, Glasgow 2020 (Miles), Gordon Research Conference on Neuroethology, Switzerland 2017 (Sillar); International Symposium on Avian Endocrinology, Edinburgh 2020 (Spencer). Cold Spring Harbor laboratory postgraduate summer course 2015-2017 (Pulver). Editorial Board: Brain and Neurosciences Advances (Ainge) Frontiers in Neural Circuits (Li), Scientific Reports (Pulver)
social	ISPP/EASP meeting on Boundaries Norms and Conflicts, Bratislava, 2018 (Reicher), Senior editorial: Associate Editor, European Journal of Social Psychology (Tausch), Associate Editor, Social Psychology (Tausch), Editorial boards: British Journal of Social Psychology (Mavor), PloS One (Cross, Dritschel)
cogact	Workshop on Science of Experiential and Qualitative Spaces, CiMEC, Rovereto 2014 (Vishwanath), SINAPSE Psychology Group Meeting 2017 (Ales), SINAPSE Annual Scientific Meeting 2016 (Ales), Scottish Vision Group Meeting 2018 (Ales, Otto, Vishwanath) Vision Sciences Society Nomination Committee 2016-20 (Harris). Editorial boards: Collabra (O'Connor), Journal of Vision (Harris), Memory (O'Connor), Psychology of Consciousness (Vishwanath), Quarterly Journal of Experimental Psychology (Jentzsch), Vision (Harris), Vision Research (Harris).

Plenaries and major research talks: PIs within the School have delivered over 160 talks or seminars at national and international conferences during the REF period, over 35 of these have been plenaries. These include conferences that reach substantial international audiences held in countries across Asia, N. America, Africa Australasia and Europe (e.g. Carpenter, 2016, International Society for Human Ethology; Call, 2016, International Congress of Psychology; Zwart, Cosyne USA, 2018; Reicher, 2017, International Conference on Mass Gatherings Medicine). Importantly several plenaries have been given at interdisciplinary meetings, facilitating contributions to not only furthering the PIs research field, but also other related fields. For example, presentations at the International Conference on Mass Gatherings Medicine in Riyadh, 2017 (Reicher) brought together social psychologists and clinical researchers. Work presented at the XXVIII Symposium of the Spanish Society of the History of Psychology, Spain 2015 (Gomez) integrated work from psychologists and historians.

Wider Activities and Contributions to Economy and Society

Examples of this impact can be found in our impact case studies (ICSs) which describe how our research has been used to fundamentally change how crowds are managed (Reicher), transform the care of end stage dementia patients (Ellis) and change UN conservation policy (Whiten). These ICSs are not isolated examples but rather part of a broad and varied impact portfolio across the School.

Response to COVID-19

Our PIs have redirected research and impact to respond specifically to COVID-19. Some projects have been reoriented, e.g. examining the effects of COVID-19 on teachers sense of agency; refocussing a project on experience of minorities to the experiences of COVID amongst Muslims in Scotland; measuring the quality of online interaction for social connectedness. A notable current impact highlight is in government policy in response to COVID-19. Reicher sits on SPI-B (the Behavioural Science Advisory group to the UK Government), the COVID advisory Group to the Scottish CMO, and Independent SAGE. He also sits on a number of specific groups which includes a strategic overview body including national and local government, the police and army, and also directly advises the police. Additionally, he has directly advised the Scottish Government on developing a public participation platform, on the messaging relating to COVID-19, on nosocomial infections and on vaccinations. Reicher has contributed to a book on the psychology of COVID-19 (Jetten, J., Reicher, S.D., Haslam, S.A. & Cruwys (2020) *Together Apart: The Psychology of COVID-19*. London: Sage), and several other review pieces aimed at academics, psychology practitioners, and policy makers (e.g. Van Bavel, et al. (2020). Using social and behavioural science to support COVID-19 pandemic response. *Nature Human Behaviour*, 1-12; COVID-19 pandemic and beyond: A call to action for psychological science

(2020) *British Journal of Psychology*, e12468). Reicher has had major exposure on COVID-19 via broadcast and social media including TV: Sky News, Channel 4 News, ITV Good Morning Britain, Peston Show, BBC News 24, BBC1 News. The School has also been involved in the production of an influential 'statistics explainer' around COVID-19 data (Cross), published in the Telegraph.

Breadth of research impact

Engagement with users and beneficiaries. By communicating with potential users and beneficiaries during the early stages of research, we have engaged with user groups in the development of projects and gained inspiration for research from user audiences. Impact has been facilitated by: (a) *research fellowships and funding* that has brought our researchers into direct contact with user groups (e.g. RSE Sabbatical Award; Wellcome Trust ISSF); (b) *membership on boards and bodies of user groups* (e.g. Expert Witness, Mental Health Foundation); (c) *consultancy* (e.g. Cabinet Office (Reicher), Independent SAGE COVID-19 (Reicher), SPI-B advisory group to Scottish Government, COVID-19; UN environment programme (Whiten)); (d) *events that bring together researchers and potential users* Networking events for dementia sufferers and carers through Alzheimer Scotland and National Dementia Carers Action Network (Ellis).

Implementation and outcomes. *(a) spin-out and product design* (e.g. Perrett has been instrumental in developing several products that have been utilised in health advocacy: face-morphing software used by anti-smoking campaigns in schools and to demonstrate the effect of a healthy diet for public demonstration and use by health educators); *(b) consultancies and positions on policy boards and decision-making panels* (e.g. Reicher regularly advises UK/international police forces and governments on public order policing; Whiten has worked with scientific advisory boards for the UN on international conservation policy); *(c) designed training programmes for practitioners* (e.g. Ellis: training courses for dementia care staff; postgraduate training courses for professionals working with adults with learning disabilities (Campbell, retired), Donaldson currently works with SportScotland (national agency for sport), EEG research with elite sports professionals, coaches and performance management teams: golf, pistol shooting, curling and rugby).

Public engagement: Our PE activities are diverse. We have taken part in or organised over 100 different PE-related projects during the REF period. These include large, externally funded interdisciplinary projects, such as the 'What kind of Mind' project, bringing Philosophy, Psychology and Evolution into schools (AHRC, collaboration with Philosophy, Gomez); the launch of 'Dementia Friendly St Andrews' training and awareness program (Ellis); the Big Brain Box (Wellcome Trust ISSF, Doherty); and the development of an Early Years area and Living Lab exhibit with the Dundee Science Centre (Inspiring Science Fund, Carpenter, Robbins, Seed).

Our engagement activities also include utilising a variety of media to disseminate our research:
a) exhibitions at local and national festivals- Each year multiple researchers form the school take part in Explorathon, European Researchers Night; Medical Research Scotland 'Meet the Researchers'; Science Discovery Day, St Andrews; Dundee Science Festival; ARUK Parkrun; Fife Schools Fair; Edinburgh International Science Festival; Grey Matter Festival and Cell Block Science. Occasional participation in British Academy Summer Research Showcase; Manchester and Media City Science Festivals and the European Science Fair.
b) *Media/TV programs*- Our research has been the main focus of the following TV programs: BBC Natural History: Primates (2020); BBC R4: The Life Scientific (2 PI's featured separately: Reicher, Hobaiter); Netflix: Babies (2020).
c) *Major public talks*- Royal Institution Christmas Lecture (2018); Royal Society of Biology Public Lecture (2015); Special Lecture at Neuro Global (NPG) Summer School, Tohoku University, Japan (2018); University of St Andrews Open Association (2016; 2017); Memories and Microscopes - An evening of free talks on dementia and Alzheimer's Disease (2017); 'How Dementia Helps us Understand our Common Humanity' - Public Lecture (2014); Fife Parkinson's

Society (2017); Café Scientifique); 'Brexit means?...for identity' - Panel member for public discussion (2018).
d) *Training and widening access summer schools*- For High Schools: REACH project (300 pupils); Sutton Trust Summer School (100 pupils); Lift Off to Success (500 pupils); Science: Fiction: Make: Believe Essay Competition (in collaboration with the Royal Society of Edinburgh – 8000 pupils); Oxbridge Summer School, Diverse Intelligences Summer School, St Andrews and ELT Science Summer School. *International summer schools*, e.g. Summer School on Shared Experiences: The Boundaries of the Social Brain, Aegina, Greece, and have organised several training/information courses, e.g. PHASE1; ABC Baby Bee.
e) *Use of social media*- Our staff utilise social media to promote their research and research within their discipline. One excellent example of this was the launch of the Great Ape Dictionary, which was promoted via several social media outlets (primarily Twitter) and resulted in one of the largest online citizen science studies with over 20,000 participants worldwide (2018). Another example is a recent article in the Conversation: Bowman has reached over 1M readers of his article about addiction.

Interaction with Industry/NGO/Governmental Stakeholders

We regularly give presentations to participant groups, which range from clinical organisations to animal production companies. For example, researchers working within the *Neuro* grouping regularly interact with the NHS and medical charities: NHS - From risk factor to drug target – finding new ways to combat Alzheimer's Disease (2014); MND Scotland open day and AGM (2017). We also regularly supervise CASE students together with industry. For example, we have partnered on BBSRC CASE studentships with optoelectronics company Cairn Research, with the British trust for Ornithology, and with pharma company Boehringer Ingelheim. In addition, recent connections have led to our expertise in animal welfare being showcased in a commercial setting (Stonegate Poultry Science Advisory Board, 2018/19). Members of this grouping are also actively involved in the Animal Welfare Research Network, funded by the BBSRC and Universities Federation for Animal Welfare (UFAW). This network brings together researchers with a range of stakeholders with the aim of innovating and maximising the impact of animal welfare research. Our pioneering research into dementia and care for those affected by this disease has also led to multiple invitations to act as an expert witness (e.g. Mental Health Foundation: Expert witness to the Dementia Truth Inquiry Panel 2014). Our expertise in this area is utilised in training relevant user groups, e.g. HSC Clinical Education Centre Belfast; Balnacarron Care, St Andrews; The University of Toronto; The University of Edinburgh, School of Health in Social Science-student nurse training; Alzheimer's Society – Train the trainer package; Alzheimer's Scotland Dementia Helpline workshop; South Ayrshire Dementia Support Association (SADSA); Scottish Speciality and Associate Specialist Psychiatric Doctors' Conference.