Institution: University of Essex

Unit of Assessment: 26 – Sport and Exercise Sciences, Leisure and Tourism

a. Overview

The Centre for Sports and Exercise Science (CSES) comprises nine academic research staff, two technicians, a Human Performance Unit (HPU) manager and an HPU sports scientist. The Centre was established in 2000. From the outset, it integrated its educational activities with a strong interdisciplinary research program, underpinned by internal and external research funding sourced from charities, industry and Research Councils. Being physically and administratively housed in the School of Biological Sciences (SBS), the Centre is able to take advantage of a range of modern biochemical, genetic and physiological facilities. However, it also benefits from strong collaborative links with other departments in the University. Within the Faculty of Science and Health these include the School of Computer Science and Electronic Engineering (CSEE), the School of Health and Human Sciences (HHS) and the Department of Psychology (incorporating the Centre for Brain Science - CBS). On-going links with social scientists have been facilitated by collaborations with the University's Institute for Social & Economic Research (ISER). Environmental aspects of the Centre's research are incorporated within the cross-faculty Essex Sustainability Institute (ESI). The Centre runs two commercial facilities for the University that underpin much of its applied research activity: the **Phoenix Club**, a Phase 4 Cardiac Rehabilitation clinic; and the **Human Performance Unit (HPU)**, a centre for athlete sports science support and physiological testing.

b. Research strategy

Members of CSES have expertise in biochemistry, biophysics, physiology, psychology and biomechanics. Complementary external expertise is readily available in the University in signal processing, computation, survey research, mathematical modelling and neuropsychology. **The broad, long term research aim of the Centre for 2014-2018 is to use its existing expertise as an enabling tool to perform interdisciplinary research that exploits the University's strengths in the biological, psychological, engineering, health and social sciences.** Research will be targeted on sports performance and health and, to this end, the nine academic CSES research staff sit in two overlapping research units (staff in italics contribute to both):

Sport Performance and Fatigue (**SPF**): Cooper, *Hettinga*, Micklewright, Parry and *Taylor*: pacing strategies; biomedical optics; biochemical control of O_2 consumption; psychological, physiological and biomechanical limits to performance. Research integration with HPU.

Health, Exercise and Active Life (**HEAL**): Barton, Gladwell, Griffin, *Hettinga*, Sandercock and *Taylor*: green exercise; gait analysis and falls prevention; cardiac rehabilitation; disability sport; indicators of cardiac and psychological health. Research integration with Phoenix Club.

b1 Delivery of CSES research strategy 2008-2013

The University's RAE 2008 strategy promised the growth of Sports Science at Essex. Since 2008, the SBS has followed an aggressive stance towards promoting this research, including significant investment (50% increase in staff) resulting in this separate REF submission. Individuals who were previously appointed as teaching fellows showing research aptitude were reassigned to teaching and research contracts, given a reduced teaching load, access to SBS research funds and University research leave. All new academic staff are expected to be research active and REF submittable. The division of research into two overlapping research areas (HEAL and SPF) has focused research activity and created critical mass whilst encouraging work at the disciplinary interface **exemplified by the following research highlights**:

SPF: (i) the development of **new biophysical optical methods of measuring performance** in elite athletes (Cooper, *Phys. Meas., MSSE*); (ii) the development of **novel theories of pacing and fatigue** in diverse populations from schoolchildren to elite athletes (Micklewright, Hettinga, Parry, *BJSM*, *MSSE*); (iii) a new **biomechanical analysis of differences in performance** between the very fastest (< 9.9 s) 100m sprinters (Taylor, *J Biomechanics, IJSM*).

HEAL: (i) Sandercock instigated the **East of England Healthy Hearts Study**, the largest health fitness survey of UK children with 10,000 participants aged 10 - 16 years. 2,000 children were measured at age 11 and followed for five years, leading to 23 peer reviewed publications, 22 abstracts and conference proceedings and five research degrees; (ii) Barton, Gladwell, Griffin,

Sandercock and Micklewright have a long standing interest in outdoor **"green" exercise"**, a term coined by Jules Pretty, the University's Deputy Vice Chancellor, who remains an active collaborator. Barton's multi-study analysis of the Essex Green Exercise programme in *Environmental Science and Technology* was featured in an editorial in the same journal issue; (iii) a psychologist (Griffin) and biomechanist (Taylor) combined to produce some of the first papers (*J. Amer. Ger. Soc.)* testing exergaming as a therapy aid in clinical populations.

Inter-departmental collaborations: In the 2008-2013 period new collaborations have been developed with Psychology in the fields of **cognitive** (Micklewright with Steffan Kennett and William Matthews; Barton and Gladwell with Ricardo Russo), **sensory** (Cooper with Arnold Wilkins) and **social** (Gladwell with Andrew Przybylski and Netta Weinstein) **psychology**. Bespoke applications to optimise Taylor and Griffin's exergaming work were explored by Simon Lucas (**CSEE**). **Funded by ESRC and BHF**, Gladwell and Barton have collaborated with Peter Lynn and Paolo De Agostini in the University's internationally recognised **ISER** and with researchers in the University's School of **HHS**.

b2. Future CSES research objectives for 2014-2019

The University's Strategic Plan for 2013-2019 aims to maximise research quality, impact and intensity in each of the University's research specialisms and foster and promote cutting-edge research at and across disciplinary boundaries. A 50% growth in size is targeted. To this end:

(a) We will facilitate the integration of our three recent appointments (Barton, Parry, Hettinga) into our research structure to maximise the quality and intensity of their research performance:

- **SPF:** We will support a new research centre in SPF, dedicated to exploring both the underlying mechanisms of fatigue and the practical sports applications of pacing. This will enable *Parry* and *Hettinga's* expertise in the physiology, coaching and biomechanics of pacing and fatigue to complement Micklewright's more psychological approach.
- **HEAL**: We will develop new research collaborations with physiotherapists and other allied health professionals in HHS. For example *Hettinga's* work on Paralympic sports, such as hand cycling, has obvious applications in rehabilitation.
- **HEAL:** *Barton's* research has, to date, been focused on users with a non-clinical agenda. The University manages the NIHR Research Design Service (RDS) for the East of England. Barton will work with the RDS to facilitate the resourcing of clinical trials, for example comparing green exercise to cognitive behavioural therapy in mild to moderate depression.

(b) We will encourage established staff to engage in research activities that are likely to have impact in sports performance and human health:

- **SPF:** We will support the application of muscle optics to elite sport. One approach is to combine the signal output with systems modelling as was previously used clinically in Cooper's MRC/Wellcome Trust-funded studies on the brain (a collaboration with UCL). See for example: (Banaji & Cooper, 2008, 'A model of brain circulation and metabolism: NIRS signal changes during physiological challenges', *PLoS Comput. Biol.* **4**: e1000212).
- **HEAL:** Exergaming research is a new field where Griffin's psychological and Taylor's biomechanical insights complement (Taylor & Griffin, 2011, 'Activity-promoting gaming systems in exercise and rehabilitation' *J Rehabil Res Dev* **48**: 1171-1186). Current research has focused on commercial games, a suboptimal approach. We will therefore explore collaborations to develop bespoke systems to assist healthcare outcomes, either via our role in the recently awarded EPSRC Centre for Doctoral Training in 'Intelligent Games and Games Intelligence', or via external software companies such as Virtualware.
- **HEAL:** Sandercock's Healthy Hearts Study is now archived in the University's UK Data Archive. To optimise the national and international impact of his follow-up study, we will provide leave for him to develop new collaborations with recognised centres of excellence e.g. the Centre for Diet and Activity Research (CEDAR), based in Cambridge.
- **HEAL:** We will expand our successful research in green exercise into a more general programme that assesses the effect of a variety of environments on physical activity. This will make use of contacts with environmental experts from the ESI (an interdisciplinary University network). However, we also wish to expand into the work environment, assessing activity levels and testing new strategies to improve lifetime health outcomes. As part of her ESRC Fellowship, Gladwell has already developed links with companies such as BAE where pilot studies are underway (Brown …& Gladwell, 2012, 'Walks4work: rationale and study design to investigate

walking at lunchtime in the workplace setting' *BMC Public Health* ***12****:* 550).

(c) We will expand links with new and existing university centres of excellence to enable our goal of fostering research at disciplinary interfaces

i. *Centre for Brain Science (CBS)*

We will probe the underlying neural mechanisms underpinning the psychological aspects of our research. We will take advantage of facilities available in the University's new CBS. These include functional NIRS (fNIRS); electroencephalography (EEG); eye-tracking; a virtual reality suite; transcranial magnetic stimulation (TMS); and other psychophysiological measures (ECG, EMG, EOG, GSR etc.). We will combine EEG expertise in Psychology with Cooper's background in fNIRS (Cooper..& Griffin, 2006, 'NIRS-detected changes in the motor cortex during mental rehearsal of physical activity' *Adv. Exp. Med. & Biol.* 578: 191-196) to determine the relative importance of brain activation and oxygen delivery. We will increasingly focus on portable, wearable brain monitoring devices as well as enabling field studies. These will allow us to utilise facilities elsewhere in the University e.g. the EPSRC-funded network media laboratory in CSEE. This incorporates 8K 3D ultra high-definition cameras with back projection; combined with bespoke customisable software. This will enable Parry and Micklewright's work on optic flow to more closely mimic real world situations (Parry...& Micklewright, 2012, 'Optic Flow Influences Perceived Exertion During Cycling', *J. Sport Exer. Psych*. 34, 444-456).

ii. *Institute for Social & Economic Research (ISER)*

ISER has a world-class team of survey and research experts that specialise in the production and analysis of longitudinal data. These skills complement the work of HEAL (in particular Sandercock, Barton and Gladwell). We will build on our existing ESRC- and BHF-funded collaborations with ISER's Paolo De Agostini and Peter Lynn. An exciting development is the inclusion of a subset of physiological data into the ESRC-funded 'Understanding Society' Survey of the socio-economic circumstances and attitudes of individuals in 40,000 British households. Sandercock will provide expertise into the interpretation of this data, in particular, patterns and predictors of handgrip strength in the general population, a collaboration being developed with Stephanie McFall at ISER.

iii. *Ageing and Assisted Living Centre*

HEAL will exploit this new initiative across the University's Faculty of Science and Health. The Centre brings together existing expertise in patient care in HHS and in cognitive (dys)function in the Psychology Department and aligns this with new technologies being developed in CSEE to impact on patient care. Example collaborations will include: combining the biomechanical expertise of Taylor with physiotherapy researchers in HHS (Jo Jackson) to explore changes in gait associated with chronic neurological dysfunction in Parkinson's Disease and Multiple Sclerosis, with the ultimate aim of using physical activity as a diagnostic or therapeutic tool; exploring the effects of physical activity on alleviating the deleterious psychological changes associated with the progression of Parkinson's Disease (Griffin with Debi Roberson, Psychology); and Griffin's work with Louise Marsland (HHS) assessing the efficacy of the music and movement service of the charity *Live Music Now* in care homes.

iv**.** *Social and Behavioural Genomics*

This new interdisciplinary facility will be the focus for research into the links between genetics, environment and behaviour. Designed to be complementary to the longitudinal data emerging from the ESRC-funded Understanding Society survey, this new genomics facility will be housed in SBS, giving CSES members ready access. Although we have interests in the long-term implications of using genomics as part of a talent identification program (SPF), we will initially target our resource and grant funding activity on the health benefits of a genomics approach (HEAL). We envisage our genomics facility becoming a key resource for studies into exercise adherence and behaviour, with implications for our research in physical activity in schools, green exercise and workplace wellbeing.

b3. Targets, resourcing and methods of monitoring attainment

Our key aim is to exploit the University's research excellence, inside and outside SBS, to underpin new interdisciplinary research themes in sports and exercise science. Our target for 2014-2019 is that each of the interdisciplinary strands of the research strategy (CBS; ISER; Age and Assisted Living; Social and Behavioural Genomics) will contribute both academically and in terms of impact. Based on our current track record (>£25K /annum/FTE) we expect a minimum of two major (>£100K) successful grant applications (RC, NIHR, EU, charity) from each of these areas and one

potential impact case study. To resource this, targeted funding (short term research fellows, studentships, consumables and equipment) will be made available as part of the University studentship allocation to SBS, the University Research Promotion Fund and SBS's own Research Fund. We will also seek to appoint new Chairs in the areas of Physical Activity and Health (linking to ISER and Age and Assisted Living) and Sports Performance/Talent ID (linking to Brain Science and Genomics). The Chair in Sports Performance will benefit from the University's new Sport Sub-Strategy (agreed in 2013). This aims to invest in physical infrastructure by building a new performance sports building incorporating Sports Science laboratories and new equipment. The University will develop a number of 'focus' sports, initially volleyball and basketball. The HPU is integral to this strategy; its Director (Parry) was recently installed as the University's Sports Performance Director.

The Director of CSES will be responsible for delivering these research goals. Progress will be reported as part of biweekly CSES staff meetings and the annual staff retreat. It will be formally monitored and evaluated at the bimonthly SBS Research Strategy Group meetings and in the CSES annual report to the Dean of the Faculty of Science and Health.

c. People, including:

c1. Staffing strategy and staff development

Staffing policy and staff development is set within the wider context of SBS, one of the largest departments in the University with 45 academic staff, 800 undergraduate and 170 research students, 45 research officers and 30 technical/support staff. In the period 2001-2008 c. 50% of CSES staff were appointed on teaching-only contracts. However, since 2008 there has been an active policy combined at both targeting staff with research potential to transfer from teaching to teaching and research (A+R) contracts and appointing new category A staff on A+R contracts. An example of this process is the appointment of a research active HPU Director (Parry) following the departure of the previous incumbent. In 2008, the Centre consisted of one Professor (Beneke) with the remainder of staff at Lecturer level. Beneke's departure in 2010 created an opportunity to re-organise the management of the research activity. As Cooper's research had moved into the area of sports and exercise science, he took over as Head of Research from Beneke and then as Director of the Centre following the retirement of Sellens in 2012. Cooper's movement into this role coincided with the appointment of two new Lecturers (Barton and Hettinga), strengthening research in the Centre in the areas of green exercise and sports pacing. The indicated policies have resulted in a dramatic turnaround in the research activity of category A staff with 90% now being on long term A+R contracts. In the meantime the School has encouraged the development of junior staff since 2008 with four Senior Lecturers/Readers (Micklewright, Gladwell, Griffin and Sandercock) now able to assist Cooper in both managing the long-term research direction of the centre and the mentoring of new lecturers and Early Career Researchers. As part of the University's strategic expansion plan we will look to appoint two new research leaders at Professorial level, one in Sports Performance (supporting SPF) and one in Physical Activity and Health (supporting HEAL). The strength of our staff development has been recognised externally e.g. the ESRC interdisciplinary career personal fellowship given to Gladwell in 2009.

Like all Category A staff within the School of Biological Sciences, Centre staff can apply for pump-priming funding for consumables, equipment and staff time from the School's Research Funds. This provides about £65K per annum to support activities that range in cost from £1K-10K. The main funding criterion is for feasibility or pilot studies to generate proof of concept data for major grant proposals or to complete a significant piece of work for inclusion in a research paper or to develop impact. A secondary criterion is the extent to which the research contributes to establishing new collaborations within the School, opening up new avenues of research and new opportunities for obtaining funding by drawing on the expertise of more than one member of academic staff with complementary expertise. Examples of success of this School Research Fund include pilot work that led to the East of England Healthy Hearts Study, the development of exergaming for falls rehabilitation, ESRC- and BHF-funded projects looking at the combined effect of the environment and exercise on cardiac and psychological health and a Leverhulme Trust-funded project modelling the effects of gasotransmitters (nitric oxide, hydrogen sulphide) on oxygen metabolism.

Early Career Researchers are explicitly favoured in their probationary years with regards to both

SBS research funding and studentships (all new staff are awarded one PhD studentship). Staff research development is facilitated by an active program of research leave, with the norm being an entitlement of one in every seven terms taken as research leave. Early Career Researchers are encouraged to take this entitlement during their probationary period. This process is managed by the Head of School and the Research Strategy Group in discussion with the Director of CSES. The School has a flexible procedure with regards to part-time working, enabling category A staff to manage their hours to suit their personal situations. Part-time status is no barrier to promotion and is taken into account. Examples include Gladwell who since 2001 has taken three periods of maternity leave, changed hours from 1.0 to 0.5 to 0.7 FTE and was promoted to Senior Lecturer in 2009.

The Centre has employed a number of **research fellows** in the period 2008-2013, mainly in the area of oxygen metabolism and green exercise. Whilst the University runs a programme to develop advanced skills for researchers, School funds can be made available if external courses would aid the development of the fellow's research career development. A robust **performance development policy** is in place for research fellows, one of the main goals of which is to ensure that their individual training needs are monitored and developed.

The Centre holds informal weekly meetings of category A staff and research fellows to discuss research developments. Fellows are also encouraged to play an active role in mentoring graduate students via leading discussions at the bi-weekly Centre research meetings. Where appropriate, research fellows are encouraged to give lectures; they are also a key supporter of taught undergraduate and postgraduate research projects. Evidence for the success of this mentoring process has been the appointment of previous research fellows to jobs in University academic positions (Barton, University of Essex), in applied sports research (Hesford, English Institute of Sport) ,and in industry (Marshall, Applied Photophysics).

The Centre has a robust **ethics procedure** managed at the School level by Sandercock. Research governance issues for all new research contracts are addressed at the level of the University's Research and Enterprise Office. It is expected that graduate students and senior research fellows will be authors of papers arising from their work in the Centre (corresponding author if they are lead researcher). Undergraduate students and technical staff are authors of a number of the papers submitted for this REF, with graduate students featuring on a majority.

c2 Research students

Research students in the Centre (Table 1) are a combination of self-funded, school research studentships and externally funded (e.g. British Heart Foundation, British Olympic Association).

Year	2008-9	2009-10	2010-11	2011-12	2012-13
FTE	12.6	13.6	12.6	11.4	11.4

Table 1. Postgraduate research students enrolled on doctoral programmes.

The SBS Graduate Director looks after the formal management of the degree process, which includes a supervisory board that reports formally twice a year to review progress, and an annual Graduate Forum, consisting of oral and poster presentations organised by the students. Students also benefit from a structured programme of training in broader research-related skills. All students have the opportunity to attend a UKGRAD-approved local GRADSchool.

In addition to this formal programme, the Centre is small enough to enable bi-weekly research meetings of all academic staff, research fellows and research students. In the first hour research students discuss their work with each other and in the second hour meet with all category A and research staff. The topics are alternately chosen by students and staff and can include: reports from conference attended; discussions of new technique and research methods; journal clubs; external speakers. The Centre also takes part in the weekly SBS external speakers' seminar programme. In 2013 it inaugurated a Summer CSES Research Conference where students and research staff were able to discuss their latest work in front of invited international experts. Research students are therefore invited to play an active role in the Centre's research agenda. Without the support and active participation it would have been impossible for the Centre to successfully host the BASES Annual Conference in 2011.

d. Income, infrastructure and facilities

Research funding has been obtained from a variety of external competitive sources:

- Work on biomedical optics funded by EPSRC (£28K from Achieving Gold in 2012 and £348K from the Life Science Initiative, joint with UCL); Olympic Medical Institute (£48K); Artinis Inc. (£11K, development of portable muscle optical devices); MRC (£277K brain oxygen delivery; joint with UCL); and BBSRC (£341K, modelling oxygen consumption via the Complexity in Biomolecular Systems Theme). The Wellcome Trust have funded clinical studies on systems modelling of oxygen metabolism (£229K, joint with UCL) with the Leverhulme Trust funding the more biological aspects (£209K)
- Green Exercise has been funded by grants from ESRC (£297K) and BHF (£90K) with smaller awards (£100K in total) from bodies such as MIND; RPSB; the Wilderness Foundation; Suffolk Wildlife Trust; Discovery Quest; and Essex County Council.
- The Centre has expertise in evaluating the success of community projects and has secured translational funding (> £200K) for this work from Colchester United Community Sports Trust; Mid-Essex PCT; South West Essex PCT; and Colchester Borough Council.

The Centre has benefitted from significant (>£2 million) University investment into new and refurbished laboratories throughout SBS. There are five comprehensively equipped Sports and Exercise Science laboratories with full access to state of the art analytical equipment in SBS. HPU staff provide support to athletes of all abilities (including those on the TASS scheme); educational services to local schools and colleges; and help manage our phase 4 cardiac rehabilitation clinic. Graduate students have access to all research facilities; there are two large open plan postgraduate research offices.

The facilities and major equipment items are organised into an infrastructure spine; maintenance, organisation of access and training is organised by specific members of the academic and technical staff to disseminate best technical practice throughout the School. Two full time technicians, an HPU manager and a HPU sports scientist are available to support research in Sports and Exercise Science. In vivo components of the infrastructure spine include: a physiology laboratory incorporating gas (Cosmed, Vicon) and blood gas (Radiometer) analysis; a biomechanical laboratory including Vicon 7-camera biomechanics system; a Kistler force plate; and a Kin-com isokinetic dynamometer; and a fully equipped vascular biology laboratory with ultrasound, EMG, ECG, blood flow and biomedical optics (fixed & portable NIR systems). Molecular tools include standard cell culture and FACS systems; bio-imaging; proteomics; production and purification of recombinant proteins; protein spectroscopy; transcriptomics; and bioinformatics. Brain activity as measured by EEG, fNIRS, eye-tracking, a virtual reality suite, TMS and Electrooculography (EOG) are available via collaborations with the CBS in Psychology.

The Centre has a flexible policy with regards to the acquisition of equipment with key resources required for the development of its research strategy purchased at School level. Recent examples include £35K for a new ultrasound facility and £20K for a second on-line gas analysis system dedicated solely for research use. Other resources are targeted towards supporting areas of national importance as evidenced by competitive grant funding. An example here would be the biomedical optics facility where a 20K fixed near infrared spectroscopy device was purchased on a Wellcome Trust Showcase Award; this was later matched by 20K from the university to fund portable devices to enable field measurements.

e. Collaboration or contribution to the discipline or research base

e1. Interdisciplinary research

As well as the internal collaborations outlined elsewhere in this document, staff form significant external interdisciplinary links. For example Cooper partners with the UCL Biomedical Optics Research Laboratory (BORL) where he holds an Honorary Professorship in Medical Physics and Bioengineering; Taylor has initiated a new sprint research group with collaborators from Germany (Marburg) and France (Lyon and Savoy).

e2 Research networks and industrial collaborations

- Research on non-invasive oxygen measurements has been funded by and/or benefitted, external users in sport (Artinis Inc.; British Olympic Association; Leicester Tigers Rugby Club;

Team GB Hockey) and health (Hutchinson Technology Inc.; UCLH Neurocritical Care Unit); two-way interactions with these end-users and system developers is crucial in informing new technology design and the development of new clinical/sporting applications.

- Green Exercise collaborations include: RSPB; Suffolk Wildlife Trust; Essex County Council; Natural England; Liverpool PCT; Mersey Forest; Mind; Wilderness Foundation; Mid Essex PCT; LEAF (Linking Environment & Farming); Discovery Quest; National Ecosystem Assessment; Vauxhall City Farm; and The National Care Farming Initiative (UK). All collaborators have funded research evaluation, received an external report, engaged in knowledge exchange at conference presentations and fed back findings to users.
- Work-place wellbeing research projects benefit and are informed by the needs of companies such as BAE systems (Advanced Technology Centre); Copella (part of Pepsico); and HG Gladwell and Sons (a local family firm).
- Hettinga is part of the European Research Group in Disability Sports (ERGIDS)
- Cooper was funded in the 13-country industrial/academic EUROBLOODSUBSTITUTES consortium. A University of Essex international patent (PCT/GB2008/002199-WO2009/004309) was granted in the USA (2013) and Australia (2013).

e3 National and International Collaborations (examples)

- Green exercise researchers publish regularly with external collaborators: J Thompson-Coon (Peninsula College of Medicine & Dentistry); Keith Gaston (University of Sheffield); Qing Li (Nippon Medical School in Tokyo); Susana Mourato and George MacKerron (LSE).
- Micklewright and Hettinga publish collaboratively in the area of pacing and fatigue with teams in: South Africa (Noakes, Lambert); Australia (Polman, Marino); UK (St Clare Gibson); Holland (Zijdewind, Gemser, de Koning); Belgium (Roelands, Meeusen); Canada (Macintosh); USA (Raglin, Foster); and New Zealand (Rowlans, Shearman).
- Taylor and Griffin's research on rehabilitation involves collaborations with gerontologists (Shawis) and physiotherapists (Impson) at the Colchester Hospital University Foundation Trust and the Regional Rehabilitation Unit of the British Army based at Colchester.

e4 Conferences, Journal Editorship and Awards

CSES staff are regularly invited as plenary speakers at international conferences e.g. **Barton** Healthy Parks Healthy People International Congress (Melbourne, 2010); **Micklewright** ACSM Annual Conference (Denver, 2010); **Sandercock** 4th International Conference on Physical Activity and Public Health (Sydney, 2012); **Griffin** and **Taylor** E-Seniors (Paris, 2010); **Cooper** Gordon Conference on 'Brain Energy Metabolism and Blood Flow' (Andover, USA, 2010); **Hettinga** VISTA Paralympic conference (Bonn, 2013) and ECSS (2013 Barcelona). Cooper sat on the Editorial Board of the Journals Essays in Biochemistry and Free Radical Research; was awarded an EPSRC Senior Media Fellowship in 2008; and a Fellowship of the Society of Biology in 2013. Gladwell won a BAE Systems Chairman's bronze award for workplace wellbeing research. Cooper (EPSRC) and Gladwell (ESRC) are members of Research Council peer review colleges. Gladwell featured in The Physiological Society's booklet, *Women in Physiology*, celebrating the UK's top female physiologists.

e5 Professional Associations

- Gladwell (Education Committee and Council of the Physiological Society); initiated the Physiological Society mentoring scheme for Women in Science
- Hettinga (Board Member, Dutch Association of Movement Science)
- Micklewright (Chair BASES Division of Sport & Performance and a BASES Director)
- Cooper (Exec. Committees of the British Biophysical Society, Inorganic Biochemistry Discussion Group of the Royal Society of Chemistry and International Society on Oxygen Transport to Tissue; Director of the Biochemical Society; Panel member HEFCE REF 2014: UoA 5, Biol. Sci; Scientific Advisory Committee, Electromagnetic Field Biological Trust.

In 2011, CSES (Micklewright, Taylor, Sandercock) hosted the BASES Annual Conference at Essex. Cooper organised symposia at the International Society on Oxygen Transport to Tissue XXV (Sapporo, Japan, 2008) and the 7th International Conference on Nitric Oxide (Edinburgh, 2012); Micklewright was a Chair at the International Convention on Science, Education & Medicine in Sport (ICSEMIS, 2012). Hettinga chaired symposia at ECSS in 2012 (Bruges) and 2013 (Barcelona) and was on the organising committee of the 4th International State-of-the Art Congress on Rehabilitation: Mobility, Exercise and Sports (Amsterdam, 2009).