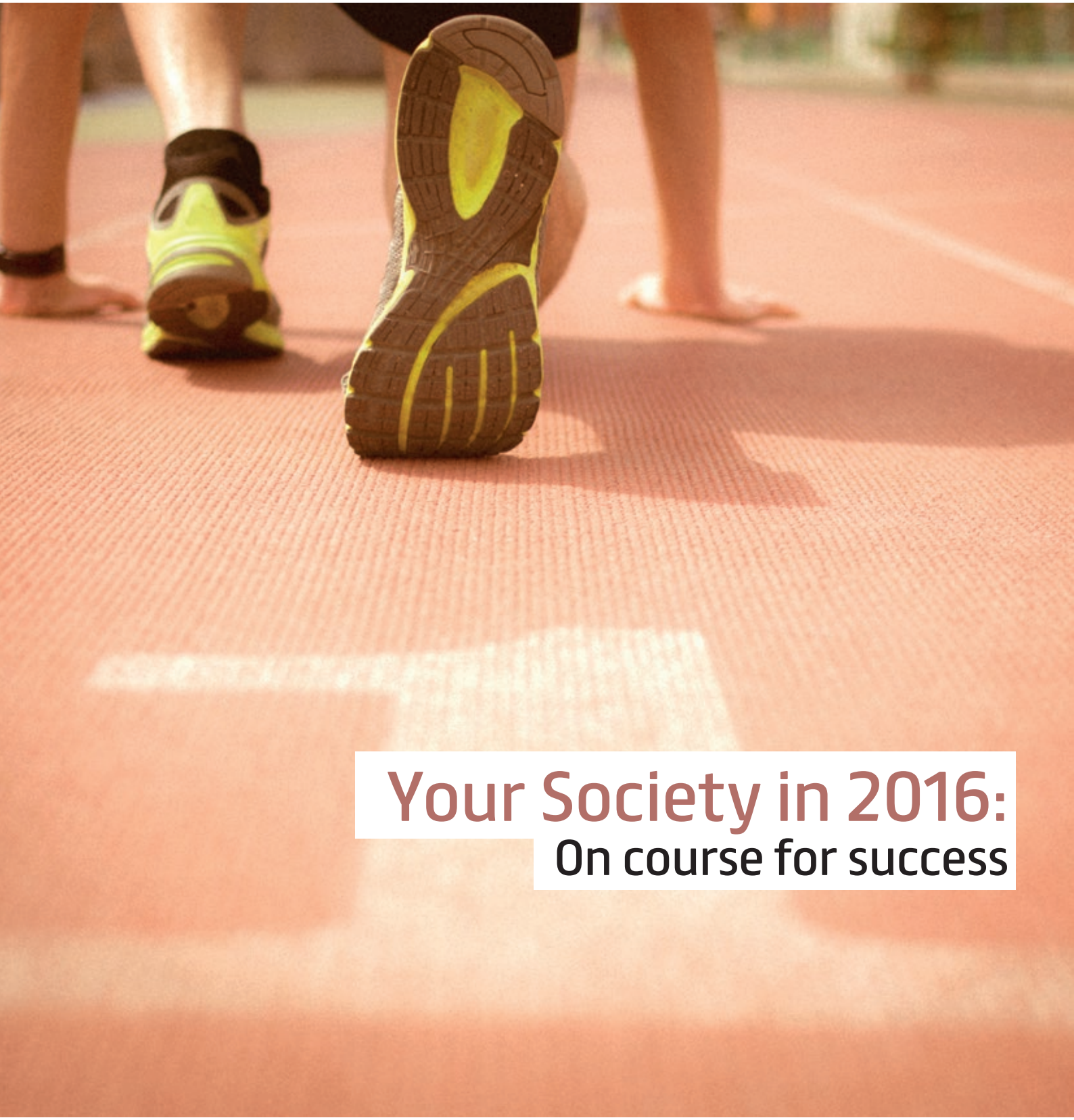
PHARMACOLOGY MATTERS

BRITISH PHARMACOLOGICAL SOCIETY

ISSN No: 1757-8175
Volume 9, issue 1 - **March 2016**



Your Society in 2016:
On course for success

Physical enhancement & pharmacology | Marathon running | Upcoming activities & meetings

BRITISH PHARMACOLOGICAL SOCIETY

Diploma in Advanced Pharmacology

Just announced

Workshop calendar for 2016

ION CHANNELS 1 June 2016 London, UK	Insights into the study of ion channels as drug targets, with particular focus on investigations in pharmacology and drug discovery using in vitro electrophysiological techniques.
STATISTICS 6 June 2016 London, UK	One day tutorial on how to select the appropriate statistical test for different experimental designs often used in preclinical science and an introduction to good experimental design, optimal sample size and statistical analysis of data published in peer-reviewed journals.
DRUG DISCOVERY 6-7 September 2016 Edinburgh, UK	A look at the process of drug discovery for small molecules and biologicals and the role of pharmacology at all stages. Topics include causes of drug attrition and the R&D approaches most commonly adopted by the industry to improve the likelihood of efficacy, safety and market approval.
GENERAL & ADVANCED RECEPTOR THEORY 12-13 September 2016 Liverpool, UK	Exploration of how common theories of drug action can be quantified and how simple receptor mechanisms can be used to interpret pharmacological data. Topics covered range from basic mechanisms to clinical application, and is appropriate for anyone with a background in the biosciences and at least one or two years of experience of laboratory experiments.
PHARMACOKINETICS & PHARMACODYNAMICS 25-26 October 2016 Birmingham, UK	A look at fundamental aspects of PKPD through concept, basic theory and practical examples reinforced with interactive tutorials on data analysis and modelling and simulation, and a chance to play an active role in analysis, interpretation and discussion.

For further details, including how to register or express an interest, please contact **education@bps.ac.uk**

Editorial

Felicity N.E. Gavins
Editor-in-Chief, Pharmacology Matters

Spring has very much sprung, and I am delighted to say that everyone at the Society and the editorial team here at *Pharmacology Matters* have been in full swing.

Firstly I must start by thanking Katharine Steer for being an absolute star in helping Pharmacology Matters run so smoothly. Katharine has now handed over the reins to Sophia Griffiths, who joined the team officially in January. I am delighted that Sophia is our new Managing Editor, and it is wonderful to have her on the editorial team, so 'welcome Sophia'.

We have yet another exciting edition. Jono provides us with insight into how The Schild Plot is delivering the Society's objectives in 2016, along with new additions to the team. Our Young Pharmacologists have also been having a "bit of a shake up", and Ross King tells us all about it and what they have been up to since our last edition.

You are all probably aware that the Society has created 'the British Pharmacological Society Ambassadors Scheme' in order to 'broaden the ways in which it engages members and disseminates information'. Katharine and Iain Greenwood discuss this thrilling new venture and introduce us to our Ambassadors.

As you will notice, this edition of PM explores the relationship between sport and pharmacology. Sophia leads our first article on this topic, with a synopsis of the recent Society-organised event: "Doping for Gold: Deterring sportspeople from risking their health, careers and lives".

In our latest "scientists and their hobbies" series, our very own editor, Christopher Tsantoulas, describes his real passion for running (having already completed 10 marathons all around Europe!) and the theory and history behind this addictive sport. He is also running in the London marathon on 24 April 2016. Good luck Chris!

David Bishop-Bailey delves into the use of 'pharmacology to cheat at sport', making us think as pharmacologists about the fine line between understanding pathways to provide health benefits, and abusing the same pathways to be able to cheat.

David Lewis (Chair of the Animal Welfare & *In Vivo* Pharmacology sub-committee) discusses what the transposition of the new European Union animal welfare directive (Directive 2010/63/EU) means with respect to the education and training of members who use laboratory animals for research or educational purposes.

We also have an action packed 'meetings update' from Barbara McDermott and Talja Dempster, along with all the wealth of exciting upcoming meeting and events for our members.

Finally, it just remains for me to 'tickle your taste buds' with the exciting news that our IT team is helping us to produce a Pharmacology Matters blog. We plan for this to go live by the end of the year, so watch this space!

Enjoy 2016!
Best Wishes,
Felicity

Contents

Your BPS 4
Jono Brüün

Young Pharmacologists update 5
Ross King

British Pharmacological Society Ambassadors: Supporting our community at a grassroots level 7
Katharine Steer & Professor Iain Greenwood

Doping for gold 10
Sophia Griffiths

Scientists & their hobbies: Running in our genes 13
Christopher Tsantoulas

Gene doping 16
David Bishop-Bailey

New Directive, new learning outcomes, new assessments 18
Dave Lewis

Meetings update 20
Barbara McDermott & Talja Dempster

Your BPS

Jono Brüün
Chief Executive

With 2016 now in full swing, the team at The Schild Plot is engaged with delivering the Society's objectives for the year ahead. These objectives were agreed by Council at the end of 2015, and will guide our activities in 2016 – meaning we will report back at the end of the year on how successful we have been! If you would like to see a copy of the Society's annual objectives, you can do so at https://www.bps.ac.uk/objectives.

Since my last 'Your BPS' column, we have been particularly active in our policy work in support of pharmacology and clinical pharmacology. We've targeted issues that directly affect our members and demonstrate the value of their expertise, giving them a stronger voice through the Society , including:

1. A response supporting ABPI report "Bridging the Skills Gap in the Biopharmaceutical Industry", which confirms the importance of *in vivo* pharmacology, clinical pharmacology and translational medicine in the UK biopharmaceutical industry.
2. A statement on industrial action by junior doctors, supporting their view that they have no option other than to strike.
3. A response to the Wakeham review of STEM degree provision and graduate employability.
4. A statement on clinical trials (following a recent catastrophic clinical trial in France), calling for improved access to early data from all such trials with significant adverse events. In addition to our statement, comment from our members on this news story made it into 1,500 media sources.

We have been busy recruiting, and have continued to grow our staff in the last few months. Shortly before Christmas, Anna Clark joined the team as Office Manager & Executive Assistant, and in January Sophia Griffiths joined us as Communications Manager. I'm pleased to say that Paul Tizard, previously our Membership Officer and one of our longest serving team members, is now our Membership Manager. Peter Wright is our new PSA Systems & Technology Manager.

The intention is that enhanced support in the BPS team will allow us to put more weight behind the projects that we have planned in 2016 and 2017. In particular, Peter Wright and David James have been working on developing new business based on our prescribing assessment expertise. Meanwhile Katharine Steer's Membership and Communications team, which now comprises four people (Kat, Sophia Griffiths, Paul Tizard and Teesha Bhuruth) should help us bring more members to the Society. We have set ourselves the target of 10% growth (equating to 110 new members) in our core 'Full Membership' category in 2016 and will report back on the initiatives we have undertaken to deliver against this objective in the coming months.

I was grateful to draw on the expertise of this team when I presented to a group of 25 undergraduates as part of Queen Mary University London's new *Pharmacology and Innovative Therapeutics* BSc course in February. Teesha helped prepare a (hopefully!) engaging talk with the title 'The British Pharmacological Society – Past, Present & Future' and it was wonderful to get out and meet some young scientists who may choose a career in pharmacology in future. I was grateful to Nick Goulding, Egle Solito and Sadani Cooray for the invitation.

With these talks running alongside our university department ambassador scheme, roving Fellows' receptions, and Bill Bowman travelling lectureships, we're working hard to ensure the Society meets its members wherever they are around the country. If you are interested in hearing about the Society from someone in the team, or a member, please do get in touch with Teesha: **teesha.bhuruth@bps.ac.uk**.

Looking forward, I'm excited about delivering our activities with the help of our members, some of whom joined Council as Trustees as of 1 January 2016:

- **Professor Steve Hill**, President-Elect
- **Professor Robin Plevin**, Honorary Treasurer
- **Professor Emma Baker**, Elected Trustee (Clinical)
- **Dr Ivor Williams**, Elected Trustee (General)
- **Dr Malcom Skingle**, Elected Trustee (Industry)
- **Aidan Seeley**, Appointed Trustee (Young Pharmacologist)

I'm sure 2016 is going to be a fantastic year for the Society.

Young Pharmacologists update

Ross King
The William Harvey Research Institute, London

First off, a happy start to 2016 to you all from the Young Pharmacologists Advisory Group! We're having a bit of a shake-up within the group as we say goodbye to a few of our members and also say hello to a couple more. We are very grateful for the long-term enthusiasm and support of members Dan Reed and Oliver Keown and our chair, Tim Warner, whose terms ended in late 2015. We welcomed the addition of two new members in summer last year (myself and Vedia Can) and at the beginning of 2016 we welcomed Adebayo Aibinu from Glasgow Caledonian University to the group.

We are also very pleased to welcome Aidan Seeley from Queen's University, Belfast, who has been appointed as the Society's Young Member Trustee. This post was created by Council to ensure that the voices of young pharmacologists are heard by the Society and are integral in shaping decision-making.

Pharmacology 2015 Symposium

In the midst of another fantastic meeting, rammed full of scientific content, the Young Pharmacologists Advisory Group organised a symposium on *MicroRNA: new diagnostics and new therapies*, co-chaired by Dan Reed and Joanne Carter. True to form, our symposium was exceptionally well-attended, and provided an excellent platform for fascinating and intense scientific discussion regarding this emerging field in pharmacology. We are especially thankful to ASPET for sponsoring our symposium and incredibly grateful to all of our speakers and staff for making our sixth successive symposium such a major success – long may it continue!

Welcome Reception & Teaching Prize

Our fourth annual Pharmacology Welcome Reception was hosted by the Young Pharmacologists Advisory Group (YPAG) on 15 December at Church House in London, where we celebrated the beginning of the Pharmacology 2015 meeting and the Student Choice Award for Excellence in Pharmacology Teaching. For the second year running, undergraduate and taught postgraduate students were asked to nominate individuals they believed to be exceptional teachers of pharmacology.

From left to right: Dan Reed (YPAG member), Joanne Carter (YPAG member), Rebecca Fox (nominating student), Dr Richard Prince (winner of the Student Choice Award for Excellence in Pharmacology Teaching), Helen Sheldon (nominating student), Laura Ajram (YPAG member), and Ross King (YPAG member).

We received many outstanding nominations and we invited students in support of Dr Alexis Bailey (University of Surrey), Dr Chris Bailey (University of Bath) and Dr Richard Prince (University of Manchester) to give a brief speech explaining why they thought their teacher deserved to win. After hearing all three nominations, judges from the Young Pharmacologists Advisory Group were thrilled to award Dr Richard Prince this highly deserved prize. Here's what Richard had to say about winning:

"I think without doubt that winning this award is one of the best things that has happened to me in 2015. Knowing the high quality of pharmacology teaching in some of the other institutions around the country, I never really expected to win. As a teaching-focused lecturer, winning any award is nice, but when it's one that comes down to students making the decisions, it means a lot more."

The Young Pharmacologists Advisory Group will continue to support the Student Choice Award for Excellence in Pharmacology Teaching and we will be welcoming nominations for the 2016 prize from students soon, please keep an eye out for this in the upcoming e-newsletters.

I'm A Scientist, Get Me Out of Here!

In November last year, I had the great pleasure of being chosen to take part in the online science communication competition; I'm A Scientist, Get Me Out of Here! The event runs over two weeks and allows school children to engage with a diverse range of scientists by asking them questions about science in general and what it's like to be a researcher. As the competition progresses, students vote to "evict" scientists until only one remains to be crowned the winner.

Even though I've done a fair bit of "science communication", "outreach" and "public engagement" in the past (I'm still not 100% on the nomenclature), I was a little apprehensive as to how much time I'd need to invest into the competition to make it a success. Luckily, I was able to participate mainly in my spare time, fitting in the live chat sessions around my lunch breaks at work, so my time at the bench didn't suffer! It was a truly fantastic experience and helped allay my suspicions that young people were becoming more and more disenchanted with science - quite the contrary. Students were very engaged, curious and many expressed a keen interest in pursuing a career in science, which is fantastic.

I am pleased to announce that I emerged victorious from the Wellcome Trust-sponsored 'Tungsten Zone', following in the footsteps of previous winner and Society member (not to mention Excellence in Pharmacology Teaching prize-winner), Richard Prince. I am very grateful to have received a prize of £500 to be spent on further public engagement activities (and also a pretty swish mug). My early plan is to create a series of podcasts/video blogs, interviewing a spectrum of younger scientists and finding out about their research and their experience in general. There is another event happening this year and I highly recommend our members to consider entering – I guarantee you won't regret it.

About the author

Dr Ross King is a postdoctoral researcher in the Centre for Microvascular Research at The William Harvey Research Institute, where he studies the contribution of neutrophils in driving inflammatory oedema. Prior to this, he graduated with a BSc (Hons) in Pharmacology at the University of Glasgow before moving to King's College London to complete his MRes and PhD studies in Cardiovascular Medical Research. His doctoral research concerned the role of sensory nerve-derived neuropeptides in the regulation of vascular inflammation associated with ageing.

British Pharmacological Society Ambassadors: Supporting our community at a grassroots level

Katharine Steer, Head of Communications & Membership and
Professor Iain Greenwood, Vice President – Policy & Public Engagement

The British Pharmacological Society ensures its activities match the needs of the pharmacology community by the continued participation of members: from delivering projects through Committees and Groups, to organising meetings, or reviewing and editing our journals. The Society is keen to broaden the ways in which it engages members and disseminates information. This has led to the creation of the British Pharmacological Society Ambassadors scheme.

Back in 2013, the Society conducted a member engagement survey, which found that:

- 84% of members agreed that the Society should expend more effort promoting pharmacology in universities
- 77% of members agreed that the Society should expend more effort promoting pharmacology in the NHS

In addition, the reduction in the number of stand-alone Pharmacology Departments and the delivery of Pharmacology within Biomedical or Life Science courses means that Pharmacology often has an identity and visibility crisis. Inherent to this is that undergraduates and post-graduates who may be interested in Pharmacology as a discipline and the activities of the British Pharmacological Society may never engage.

In response, the Policy & Public Engagement (PPE) Committee has created a network of local ambassadors to help deliver the Society's objectives by:

- Promoting pharmacology in organisations at a local level
- Providing guidance and support to pharmacologists
- Ensuring that the Society represents the interests of members, by disseminating information about activities and gathering feedback.

Countdown to launch

Ahead of launching the Ambassadors initiative, we've listened to advice from participants and organisers of similar schemes in other Learned Societies. In addition, input from our Membership & Awards Committee and Trustees on Council was gratefully received. This helped us develop a "job description" for a British Pharmacological Society Ambassador, which involves:

- Taking opportunities to promote pharmacology and the Society to members, fellow scientists, students and the public (these may be varied according to each Ambassador's special interests).
- Communicating to the Society any local issues and cutting edge scientific developments at their institution that would be of significance for the Society's operations and/or the wider pharmacology community.
- Identifying and making recommendations on the needs of members to the Membership Team and/or the appropriate committee on an ad hoc basis as required.
- Identifying and making recommendations on how to improve the Ambassadors scheme, with examples of best practice and less successful activities.

It is a long-term goal of the PPE Committee that every institution has a British Pharmacological Society Ambassador that is tasked with transmitting Society information as well as receiving input from their 'constituents'. If there was appetite for this, the Ambassadors scheme could also be rolled out internationally.

In order to better understand how rolling out a wider scheme might work best for the pharmacology community, and the support needed from the Society's office and finances, the PPE Committee has launched an initial two-year pilot with a small group of Ambassadors in the UK and Ireland. This pilot started in June 2015, so by early 2017 the Committee should be able to decide how and when the scheme could be expanded to all institution: making this decision will rely on regular updates and feedback from the pilot Ambassadors, as well as collecting evidence of impact along the way.

Introducing our Ambassadors

In 2015, the Society sought expressions of interest from members from across universities, the NHS and industry, who would be able to support us by volunteering for the initial two-year pilot. Eligible members received messages from Professor Humphrey Rang, and details were also included in the Society's e-newsletter.

We are pleased that PPE Committee appointed the following Ambassadors:

Dr Aisah Aubdool,
King's College London

Dr Samir Ayoub,
University of East London

Dr Paul Chazot,
University of Durham

Dr Yvonne Dempsie,
Galsgow Caledonian University

Dr Amos Fatokun,
University of Bradford

Professor Alasdair Gibb,
University College London

Dr Daniel Hawcutt,
University of Liverpool

Dr Breandán Kennedy,
UCD Conway Institute

Dr Anne Leaver,
University of Edinburgh

Dr Anja Mueller,
University of East Anglia

Dr Richard Roberts,
University of Nottingham

Dr Shori Thakur,
University of Hertfordshire

Dr Steven Tucker,
University of Aberdeen

The Society has granted each Ambassador:

- The title of British Pharmacological Society Ambassador.
- Materials relating to the Society and its activities.
- Ad hoc support and advice from the Society's staff.
- Reimbursement for travel and subsistence costs, in line with the Society's travel expense policy, to attend an annual roundtable meeting with other Ambassadors in order to network, provide feedback and share best practice.
- A complimentary ticket to the Society's Annual Dinner.
- An indicative budget of £500 each year to be spent in the promotion of pharmacology in their institution, in support of the Society's strategic objectives.

Members in any of these institutions shouldn't hesitate to contact their Ambassador. Further information about the role of Ambassador is available from the Society's website at **www.bps.ac.uk**.

What to expect from the Ambassadors!

At Pharmacology 2015, all thirteen Ambassadors came together for a roundtable meeting. This was the first chance for them all to meet face to face, and discuss their exciting plans for the coming months. Many activities were at an early stage of planning but already included:

Scientific conferences and lectures

Public engagement events and talks

Networking events

Engaging with (and setting up new) local pharmacology societies

Outreach and talks for sixth form/ college students

Supporting institutions without ambassadors

Promoting the Society to students and colleagues

This creative, experimental approach to the Ambassador role is heartening to see at this early stage and something we want to encourage in the future. The Ambassadors are keen to share their progress with *Pharmacology Matters* readers – so please look out for their articles in future issues!

Have your say

The Ambassadors pilot was inspired by the 2013 member engagement survey. A follow up survey will be launched to compare how members' opinions of the Society have developed in the last three years. Members should look out for an invitation to participate arriving in their email inbox later in 2016!

International member engagement

20% of the Society is based outside the UK and the Membership Committee is reviewing how we can better engage this important group. A survey involving our over 800 international members was completed in January and February 2016, which will form the basis for a new international strategy that will be announced later this year – watch this space!

Doping for gold

Sophia Griffiths,
Communications Manager

In February of this year, I had the pleasure of attending 'Doping for gold: Deterring sports people from risking their health, careers and lives', an event organised by the British Pharmacological Society as part of the Brighton Science Festival.

The Society had invited Professor David Cowan OBE, and Tim Foster MBE to speak, and Sile Lane to chair discussions given our ongoing support for Sense about Science's public engagement activities, where she is Director of Campaigns.

David is a member of the British Pharmacological Society and Director of the Drug Control Centre at King's College London. Back in 2012, he was Director of the Anti-Doping Science Centre that analysed all the samples collected as part of the anti-doping programme at the London Olympic Games.

Tim was a member of the GB Rowing Team for thirteen years, competing at three Olympics and winning gold in Sydney 2000. He went on to coach at the highest level for a further twelve years, leading both the British and Swiss national teams, and preparing athletes for a further three Olympics Games.

Tim Foster (centre left) with teammates after winning gold at the 2000 Olympics in Sydney.

From left to right: Tim Foster, Sile Lane and David Cowan on the evening of the event.

I found it fascinating to hear their different insights on the anti-doping debate – one from a scientific angle and one knowing the day-to-day pressures faced by coaches and athletes.

David acknowledges that the scientific community must develop testing methods and keep up with potential new ways in which athletes could misuse drugs to enhance their performance (for examples of these, see pages 16–17 on gene doping). In contrast, Tim is focused on avoiding anything that could put athletes at risk of doping, including the risk of consuming banned substances accidentally in supplements. Reputation remains an important factor for athletes and coaches – ultimately Tim sees it as his responsibility to ensure that doping wasn't even an option for the athletes he coaches.

There was a great deal of discussion about the 'culture' around doping and how changing this was one of biggest, if not the biggest, challenges for keeping athletes clean. This doesn't seem like it will be easy though: Tim and David argued that not only would this require support from those involved in elite sports, but also public engagement to encourage them to hold the few athletes that do dope accountable for their actions.

The audience was extremely involved on the evening, with nearly everyone asking a question. All-in-all, it was a great success with nearly two hours of discussion.

I will be sharing my report with the Society's Policy & Public Engagement Committee. The Brighton Science Festival event was the first phase of a new campaign for the Society led by the Committee, which will explain the value of pharmacology in the modern world by engaging with the issue of drugs for performance and image-enhancing purposes not only at elite levels but also among young people at the grassroots. Please look out for this campaign as it "gets off the blocks" later this year.

About the author

Sophia Griffiths is the Communications Manager at the British Pharmacological Society. She received her masters in science communication from the University of Leeds, after completing a BSc (Hons) in biology in the USA.

BRITISH PHARMACOLOGICAL SOCIETY

TODAY'S SCIENCE TOMORROW'S MEDICINES

Save the date

PHARMACOLOGY 2016

13–15 December
The Queen Elizabeth II Conference Centre, London

For more information about attending or presenting please contact **meetings@bps.ac.uk** or visit **www.bps.ac.uk**.

The British Pharmacological Society is delighted to announce initial details for our annual meeting, Pharmacology 2016. The latest research from across the whole spectrum of pharmacology will be the focus for plenary lectures, oral communications and poster sessions. There will also be invaluable opportunities for participants to network with pharmacologists from the UK, Europe and overseas.

Symposia

Cardiovascular & Respiratory Pharmacology

- From bench to bedside: Targeting the pathophysiological responses of ischemia-reperfusion injuries
- BSCR embedded symposium: Targeting cardiovascular GPCRs using biased agonism
- Nanomedicine in pharmacology

Neuropharmacology

- Uses and challenges for human pharmacology studies to understand CNS diseases
- Fatty acid amides (aka lipoamines) beyond cannabinoids

Integrated & Systems Pharmacology

- The long reach of the bowel: Translating microbiome science into therapeutics for systemic human diseases
- Study, development and rationale Use of immunopharmacological agents
- Immuno-Oncology: From bench to bedside

Molecular & Cellular Pharmacology

- Non-traditional/orphan GPCRS as novel therapeutic targets
- Biochemical strategies in drug discovery and targeting
- Anti-tumor pharmacology and traditional Chinese medicine

Drug Discovery, Development & Evaluation & Toxicology

- Organ-on-a-Chip technology - the future of physiological profiling?
- Clinical application of systems pharmacology models
- Clinical pharmacology, pharmacokinetics and pharmacogenetics in pregnancy (C4P)

Registration & abstract submission

Further details will be announced in June 2016.

Exhibition & Sponsorship

By having exhibition space or sponsorship package at Pharmacology 2016 you will be reaching an audience of approximately 1,000 scientists. This well-regarded conference provides an informal yet professional environment in which to highlight your products and services.

For further information about how you can support Pharmacology 2016, please email **meetings@bps.ac.uk** or visit **www.bps.ac.uk**.

Scientists & their hobbies: Running in our genes

Christopher Tsantoulas
King's College London & *Pharmacology Matters* editorial board member

Visit any city park during the day and you will undoubtedly come across casual joggers, running clubs, parents pushing hi-tech jogging strollers, sport shoe-wearing professionals commuting to work and so on. The substantial running culture of modern life is also reflected in a plethora of running events that come in all shapes and sizes: from 5km park runs, obstacle races and zombie runs, to more challenging activities such as trail running and marathons (42.2km). I too am a runner; shortly after my PhD I decided the time was ripe to end a 14 year-long smoking spree and attempt my first marathon. Five years later I have completed 10 marathons all around Europe, and there is no sign of slowing down.

Most people do not realise our exceptional running endurance amongst the animal kingdom. Case in point: the Man versus Horse race in Wales was fashioned in 1980 as a result of a pub bet and has been held annually ever since. This 24 mile cross-country event sees runners competing against horses to claim a grand prize of thousands of pounds. What is perhaps more striking than its eccentricity, is the fact that most races are close calls and human has beaten beast twice.

According to a popular theory, this surprising running capacity was a trait selected by evolution because it provided a survival advantage through hunting. Although we are no match for the top speeds achieved by e.g. a leopard, endurance running is a whole different story as it crucially relies on the ability to avoid overheating. For most animals thermoregulation depends on a crude system of heat exchange through panting. In contrast, humans have evolved a highly sophisticated mechanism of cooling down – sweating – and scientists believe that this superior ability was instrumental in hunting prey. This thought may raise a few eyebrows, but there are documented observations of ancient tribes that still hunt precisely in this way. Typically, a group will meticulously chase an animal over tens of kilometers, constantly leading it into the sun. After many hours the heat-exhausted animal is easily captured and feasted on.

But surely, this trait is no longer relevant in modern societies of ingredient availability, restaurant abundance and take-away convenience – so why do modern people run long distances? Answering this question necessitates considering the physiological responses during a marathon.

"Le soldat de Marathon" by Luc-Olivier Merson. The modern marathon was born in ancient Greece, following victory over the Persians at the battle of Marathon. According to the legend, the Greek soldier Phidippidis run a distance of approximately 42km to Athens and allegedly died of exhaustion upon delivery of the triumphant message. The annual Athens marathon is run along the original route that Phidippidis followed. (Photo is licensed under CC 2.0 BY).

At the start line, an excited and anxious brain triggers the kidneys' adrenal glands to secrete adrenalin into the bloodstream. This adrenalin rush increases cardiac and respiratory rate, supplying the muscles with adequate blood and oxygen for the ensuing action. The bulk of required energy is provided by aerobically burning blood-glucose and muscle glycogen. This highly efficient process is adequate for most of the race and within the first hour you experience the first reward of the marathon, the "runner's high". This euphoric feeling renders everything more effortless and pain-free, and has long been attributed to accumulation of the body's natural opioids called endorphins. Interestingly, recent experiments suggest that exercise can additionally activate the endocannabinoid system, also known for its pleasure-conferring and pain-relieving effects[1]. Therefore, it may be that endocannabinoids work synergistically with endorphins to establish the pleasurable mental sensations of the runner's high.

The Man versus Horse race is held every summer in Wales and sees humans competing horses for a substantial grand prize. In 2004, British athlete Huw Lobb was the first to pick up the £25,000 jackpot by outrunning 500 humans and more than 40 horses. (Photo by Roger Kidd is licensed under CC BY 2.0).

Unfortunately, the aerobic energy system is not sufficient to cover the high energetic demands of prolonged exercise. The missing energy is provided by concurrent anaerobic glycolysis, which releases lactate in the bloodstream. The lactate can be recycled by the liver to provide even more energy, however as exercise persists the clearance rate will eventually be overtaken by lactate production. In training lingo this is called the "lactate threshold", and results in accumulation of hydrogen ions which cause muscle soreness by sensitising pain-sensing nerve endings. So this is when things start to hurt a bit.

And then there is the dreaded "wall" – a sudden wave of exhaustion around the 32km mark that feels like invisible, immensely heavy weights on your legs. This invariably occurring experience signifies the onset of glycogen depletion – you have simply used up all glucose in your tanks (~2,000 calories) and are running on empty. At this point the body is forced to switch to an alternative source of fuel: lipids. The good news is that the human body can store a lot of fat, theoretically enough for about 30 marathons. The downside is that extracting energy by burning lipids is a much slower process, which is why everything feels so sluggish, senses go numb and mental abilities are compromised (ask any runner at this stage to perform a simple maths calculation). In addition, fat burning uses up more oxygen which sharply accelerates anaerobic metabolism and resultant muscle soreness. To make things worse, the sustained mechanical stress creates micro-tears on muscle fibers which become loci of inflammation. It is also at this point that cramps and old lurking injuries tend to appear. Overcoming this cascade of events constitutes a mental rather than a physical struggle, and this is where the vast sense of achievement lies for most people.

Of course the race is only the climactic finale of the marathon journey and athletes can enjoy many fitness improvements in the preceding months of preparation – which altogether may even cushion the fall on that wall. Increases in heart stroke volume and muscle capillarization improve delivery of oxygen and fuel, as well as removal of toxic waste products. Training also expands glycogen stores in the muscles and liver, effectively upgrading the energy tank capacity. Slow long runs (typically on Sundays) enhance the body's ability to utilise lipids as an energy source – an effect that has been recapitulated in mice by enhancing production of a protein called peroxisome proliferator-activated receptor delta (PPARδ)[2]. Muscle fibers go through alterations that optimise energy production; number and size of mitochondria are augmented and the activity of aerobic enzymes is boosted.

Like most traits, marathon running ability depends on the interplay of genes and environment. For instance, elite marathon runners are typically born with a higher percentage of slow-twitching muscle fibers (primarily engaged in endurance sports) than fast-twitching fibers (reserved for activities such as sprinting and jumping). Interestingly, training can affect muscle so profoundly that fast-twitching fibers begin to acquire characteristics of slow-twitching fibers.

A gene implicated in this phenotypic switch is α-actinin-3 (ACTN3), polymorphisms in which are frequently found in top endurance athletes. Mice lacking ACTN3 run 33% farther than controls on a treadmill and this was coupled to improved aerobic metabolism[3]. Based on analysis of genotype frequencies in human populations, the authors suggested that ACTN3 mutations may reflect an adaptive advantage for modern humans, traced back to the first migration out of Africa 60,000 years ago. Another group engineered their own mouse champions by silencing hypoxia-induced factor 1α (HIF-1α), a gene involved in switching muscles from aerobic to anaerobic activity, although in this case an increased tendency for muscle damage was observed[4].

Elite marathoners (shown here competing in the London marathon) have a genetic make-up that favours endurance running. (Photo by Pete Sheffield is licensed under CC BY 2.0).

What are the limits of human running endurance? Advances in nutrition and training regimes have brought the marathon world record from 02:55:18 (Hayes, 1908) down to 02:02:57 (Kimetto, 2014) and reignited the debate on whether a sub-two hour marathon is humanly possible. Running 42.2km at 2m51s/km (4m35s/mile) is a barrier considered by many as the utmost challenge left in sports. However, if achievable, chances are the runner capable of this feat has already been born; based on the projectory of historical world record improvement, we can postulate that the two-hour mark will be broken within the next 10–15 years. This runner will most likely have an immaculate genetic profile, excellent running economy, impeccable oxygen capacity, small body size, chronic exposure to high altitudes and have undergone a significant amount of physical and mental training. In addition to these attributes, a sub two-hour marathon will have to be run under ideal weather conditions (<5^{0}C with low winds), on a pancake-flat course (e.g. Berlin), with top-notch pacemaking and teamwork to nullify air resistance.

I personally enjoy running independently of performance. I find it brings balance by keeping both body and mind vigorous. In today's busy era, spending uninterrupted time with your thoughts is a luxury. Running is my problem-solving session; somehow the natural surroundings, synchrony of leg turnover, rhythmic breaths and heartbeats all work to focus your thoughts. Trivial issues are filtered away and substantial matters are approached with newfound clarity. The most pronounced occurrence of this is when you hit the wall late in the marathon, where imagery and willpower become essential for squeezing out some extra energy. This can be a very dark and lonely place and I have never felt more emotionally stripped down but also in tune with myself than in those moments. In many ways the marathon journey is a simulation of life itself – persisting and triumphing over the adversities redefines your limits and facilitates the valuable realisation that nothing is beyond reach.

References

1. Fuss J et al. A runner's high depends on cannabinoid receptors in mice. *Proc Natl Acad Sci U S A*. 2015: 112(42):13105-8.
2. Wang YX et al. Regulation of muscle fiber type and running endurance by PPARdelta. *PLoS Biol*. 2004: 2(10):e294.
3. MacArthur DG et al. Loss of ACTN3 gene function alters mouse muscle metabolism and shows evidence of positive selection in humans. *Nat Genet*. 2007: 39(10): 1261-1265.
4. Mason SD et al. Loss of skeletal muscle HIF-1alpha results in altered exercise endurance. *PLoS Biol*. 2004: 2(10):e288.

About the author

Christopher Tsantoulas received his BSc in Biology from University of Athens in 2003. Following a Master's in Molecular Medicine at University College London, in 2010 he completed his PhD on "The Role of Potassium Channels in Neuropathic Pain" at King's College London. After post-doctoral positions in Pfizer and University of Cambridge, he returned to King's College where he is researching peripheral pain modulation at present. He is currently training obsessively for his 11th marathon this April in London, where he hopes to break three hours.

Gene doping

David Bishop-Bailey, FBPhS
Royal Veterinary College, University of London

The use of pharmacology to cheat at sport has been widespread for decades – from the past abuses of Lance Armstrong and members of the professional cycling fraternity, to the recent banning of Russian athletes from international competition. There is also a worrying trend towards the use of illegal and experimental compounds in amateur sports or for image-enhancing purposes. Even with advanced testing and the development of 'biological passports', it is clear that doping and the illegal use of unlicensed pharmaceuticals is a huge issue.

Many dopers such as Armstrong were never exposed while doping. Having said this, there have been clear efforts involving athletes such as Chris Froome and Paula Radcliffe, to show they are clean, going to the lengths of releasing their blood data in the public domain and undergoing physiological testing. High-performing athletes who test clean have unfortunately been tainted by the same suspicions as those that have doped and were not caught at the time. As testing becomes more sophisticated, dopers continue to succeed in finding ways to beat the testers. Those participating in doping are using our professional expertise to both cheat and actually put individuals at risk to their health.

Over the last 20 years there has been an explosion in the interest of the molecular and biochemical processes that mediate the response to exercise. These advances pave the way for novel therapeutic approaches for a wide variety of chronic diseases (that exercise is known to be protective in), but also open up the possibility of novel and more complex avenues for abuse in sport.

The World Anti-Doping Agency lists a whole range of banned substances that will be familiar to most pharmacologists, including: anabolic androgenic steroids, erythropoiesis-stimulating agents, human growth hormone, insulin-like growth factor-1, β2 adrenoceptor agonists, aromatase inhibitors, selective estrogen receptor modulators, agents modifying myostatin function, insulin, peroxisome proliferator-activated receptor-β/δ (PPARβ/δ) agonists and PPARβ/δ-AMP-activated protein kinase (AMPK) axis agonists, along with diuretics and similar agents that can be used to mask the use of drugs[1].

This list includes well-established pharmacological doping drugs, but also reflects new experimental evidence of emerging pathways linked to exercise enhancement in animal models. Sophisticated dopers turn to science to gain an advantage and anti-doping bodies need to respond quickly to add potential agents to the banned list.

As mechanisms of exercise become unravelled, they are often picked up by the athletic, and in particular, the bodybuilding community. A simple internet search for the experimental PPARβ/δ activator GW501516 shows that the first actual piece of science has been pushed back to the fourth page of search results. GW501516 was a drug developed for dyslipidaemia but halted during clinical development due to causing cancer in long-term rodent studies[2]. It is now sold in an unlicensed form over the internet as a performance-enhancing drug and even given 'trade'-like names of Endurobol and Cardarine.

As metabolomic and proteomic approaches develop, unusual non-natural drugs should be easier to detect and biological signatures of doping will hopefully become clearer. Detection of endogenous mediators like erythropoietin or human growth hormone is more difficult, but synthetically manufactured recombinant proteins do often differ from the isoforms found in the circulation. Some challenges remain with designer drugs that are not currently detected as well as drugs that are short lived (i.e. removed from the body very quickly), such as micro i.v. dosing of erythropoietin.

Gene doping in contrast to pharmacological doping is the misuse of gene therapy to modulate the exercise phenotype. A number of recent advances in our understanding of what regulates exercise phenotypes, like many other fields, have come from the investigation of transgenic or knockout mice[3]. Here, identified pathways for which no chemical activator or inhibitor exists can be tested by a molecular biology approach. But would a gene doping approach actually work? There are rare polymorphisms in the human population that would suggest a change to a single gene can give greatly elevated athletic ability. Of particular note is a rare EPO receptor mutation identified in the Finnish multi-Olympic cross-country ski

champion Eero Mäntyranta (1937–2013), which resulted in a calculated increase in oxygen carrying capacity of up to 50%.

With a gene doping approach, DNA encoding molecules such as enzymes or receptors, transcriptional regulators or even designer transcription factors (constitutively active, dominant negative, chimeric proteins) would be inserted and present only in a target tissue (and potentially not released into the circulation). We have also recently entered a new age of gene knockdown (short hairpin RNA) and gene-editing technologies such as TALEN or CRISPR that allow both knockout and more subtle modification of target DNA. Inserted or edited DNA can encode mediators that are produced and act in a paracrine manner, so that concentrations are high locally, but diluted in the circulation.

Modification of transcription factors or receptors working at the intracellular level may not be detected in the circulation. Commonly, only blood and urine are tested. Therefore, testing for gene doping poses significant challenges: tissue biopsies containing the gene of interest may be needed, making gene doping extremely difficult to detect.

So is gene doping already occurring? In molecular biology terms, obtaining a target gene to modify is relatively simple. The limiting factor is getting any target to work effectively in man. Gene therapy and especially gene editing are showing great potential and are now being used on a regular basis in animal models, but are still in their infancy in the clinic. There is little evidence for example that directly injecting plasmid DNA or using more efficient viral vectors give rise to a significant long-term expression of the transgene in humans[4]. Success in human gene editing has been achieved by treating cells ex vivo and then reintroducing them to the body, e.g. correcting adenosine deaminase-deficient severe combined immunodeficiency[5], or the recent report of gene editing of the CCR5 receptor in HIV patient T-cells[6].

It does seem only a matter of time before gene therapy delivery methods are improved to overcome this major limitation of long term expression of the transgene. Part of the failure for the speed in translation in gene therapy is rightly due to ensuring patient safety with these new techniques. Illegal users may not have the same safety concerns. In reality, gene doping may still also be detectable.

Injection of a gene is unlikely to be 100% tissue specific, so some will invariably enter the circulation. Moreover, if the insert is in muscle, extreme exercise can lead to muscle damage, which may also release detectable components of the gene-doping machinery in the circulation. Rather than detecting the unknown insert, there are few suitable vectors that would be seen as foreign and could be analysed based on their common structure or sequence. None of these are currently tested.

Lastly, aberrant gene expression may alter the metabolic profile of the individual in a manner that distinguishes it from the natural exercise phenotype. For example, comparing the transcriptomes of mice that were exercised to those gene- or pharmacological- doped with PPARβ/δ indicated it is possible to distinguish authentic exercise from PPARβ/δ-induced or enhanced exercise[7]. Therefore, although costly, metabolomic profiling (akin, but more detailed to the current athlete's biological passport), or transcriptomic next-generation sequencing of blood cells or biopsies, has the potential to identify patterns of doping (by pharmacological or gene mechanisms), distinct from the natural response to exercise.

Although, one cannot rule out highly and wealthy organised doping programmes like the state-sponsored programmes of the old Eastern bloc, similar to pharmacological doping, gene-doping will likely emerge copying successful gene therapy trials. As pharmacologists, we should continue to study these pathways and advance these techniques to find therapies providing health benefits, but we should also be aware of how these pathways can be misused and detected.

About the author

Dr David Bishop-Bailey is currently Senior Lecturer in the Department of Comparative Biomedical Sciences at the Royal Veterinary College, University of London. He is currently a Fellow of the American Heart Association, the British Pharmacological Society, the Higher Education Authority and The Royal Society of Biology.

References

1. World Anti-Doping Agency [online]. The World Anti-Doping Code: The 2013 Prohibited List. 2013 [cited 31 March 2016]. Available from: https://wada-main-prod.s3.amazonaws.com/resources/files/WADA-Prohibited-List-2013-EN.pdf
2. Geiger LE, Dunsford WS, Lewis DJ, Brennan C, Liu KC, Newsholme SJ. Rat carcinogenicity study with GW501516, a PPAR-delta agonist. *The Toxicologist* 2009: 108(1) 895.
3. Bishop-Bailey D. Mechanisms governing the health and performance benefits of exercise. *Br J Pharmacol*. 2013: 170(6):1153-1166.
4. Gould D. Gene Doping: Gene delivery for Olympic victory. *Br J Clin Pharm*. 2013: 76(2):292-298
5. Gaspar HB, Cooray S, Gilmour KC, Parsley KL, Zhang F, Adams S, Bjorkegren E, Bayford J, Brown L, Davies EG, Veys P, Fairbanks L, Bordon V, Petropoulou T, Kinnon C, Thrasher AJ. Hematopoietic stem cell gene therapy for adenosine deaminase-deficient severe combined immunodeficiency leads to long-term immunological recovery and metabolic correction. *Sci Transl Med*. 2011: 3(97):97ra80.
6. Tebas P, Stein D, Tang WW, Frank I, Wang SQ, Lee G, Spratt SK, Surosky RT, Giedlin MA, Nichol G, Holmes MC, Gregory PD, Ando DG, Kalos M, Collman RG, Binder-Scholl G, Plesa G, Hwang WT, Levine BL, June CH. Gene editing of CCR5 in autologous CD4 T cells of persons infected with HIV. *N Engl J Med*. 2014: 370(10):901-910
7. Narkar VA, Downes M, Yu RT, Embler E, Wang YX, Banayo E, Mihaylova MM, Nelson MC, Zou Y, Juguilon H, Kang H, Shaw RJ, Evans RM. AMPK and PPARdelta agonists are exercise mimetics. *Cell*. 2008: 134(3):405-15.

New Directive, new learning outcomes, new assessments

Dave Lewis, Chair of the Animal Welfare & *In-Vivo* Pharmacology Sub-Committee

The transposition of the new European Union animal welfare directive, Directive 2010/63/EU, into the national legislation of all EU member states in 2013 has changed the way in which education and training for colleagues who use laboratory animals for either research or educational purposes is delivered. Whilst there have been no substantial changes in the content of UK laboratory animal science training courses, how they are assessed is being overhauled.

Addressing variability in education and training across Europe

Previous to the 2010 Directive, animal welfare legislation varied considerably across the EU; some countries had no animal welfare legislation whilst in others it was limited in scope. Similarly, there were countries where there were no mandatory laboratory animal sciences training courses for researchers, training was acquired *"on the job"*. With the implementation of the new Directive, all people involved in the use of laboratory animals for research or educational purposes, including animal care personnel, must now be adequately educated and trained before participating in these studies.

To ensure parity of educational experience and to facilitate the movement of researchers across Europe, a pan-European modular course structure has been adopted, with clear educational learning outcomes for each module. Education and training undertaken in one member state should eventually be recognised and accepted in another without the need to re-train. It is no longer a *"one size fits all"* programme; courses and modules to be completed are tailored to your role or function, for example, whether you design studies or actually undertake them. There is a requirement for each person to be competent which, in the UK, has been interpreted as a need for you to be assessed (and re-assessed at regular intervals) on your technical competencies. You also have to engage in continued professional development and training in laboratory animal sciences and welfare throughout your career.

Implications for UK courses

In the UK, when our current laboratory animal welfare legislation, the Animal (Scientific Procedures) Act or A(SP)A, was introduced in 1986 there was no requirement to undertake training. Compulsory modular training courses for Personal Licencees (modules 1–4) were introduced in 1994, with module 5 training for Project Licence Holders following in 1995. These training courses are provided by either academic or commercial organisations, with courses accredited by one of three bodies recognised by the Home Office: the Institute of Biology (as it was then known), the Universities Training Group or the Scottish Accreditation Board.

Implementation of the new Directive and the subsequent modifications to A(SP)A has resulted in limited changes to course content in the UK; the new European education and training learning outcomes being very similar to those published by the UK Animal Procedures Committee in 2006. Changes required by the modification of A(SP)A and its linked "*Guidance on the operation of A(SP)A*" have been incorporated into modular training courses as these have come into force, with courses restructured to provide training specific to each of the new categories of personal licencee (PIL A etc). There will be an increased use of e-learning resources (e.g. the anaesthesia for minor procedures resource (EU module 20) developed by Paul Flecknell and colleagues at Newcastle University) and a requirement for prior self-directive learning, freeing up course time for more active learning approaches.

New UK assessments

The most significant change will be in the assessment of these courses. Knowledge acquired from individual modules was previously assessed predominantly through the use of MCQs and short answer questions. However, the new EU learning outcomes require a higher level of learning which cannot be assessed with these methods. Candidates will need to demonstrate knowledge, understanding and comprehension, reflected in a change of the wording of the learning outcomes from "indicate or label" to "describe, discuss or demonstrate".

The three UK accrediting bodies have been working together to totally re-vamp the assessments for both personal and project licensee training courses. The format of MCQs has changed to five answers for each stem, each of which may be true or false. New assessment tools have been introduced including extended matching questions (EMQs) and missing word or phrase questions. With the intention of introducing e-marking in the future, assessment methods that cannot be marked electronically, such as short answer questions, will not be used. A key change will be the introduction of a limited number of "killer questions"

on papers, covering essential knowledge in ethics, law or responsibility. An incorrect answer to any of these will result in immediate failure of the assessment irrespective of marks obtained in the rest of it. Exams will be closed book, with normally a period of seven days between the end of the course and its assessment. These new assessments will shortly be trialled on some courses, with the expectation that they will be fully introduced by the end of 2016.

Assessing practical competencies

The Directive also requires the assessment of practical competencies for EU modules 21 and 22 (Advanced anaesthesia for surgical or prolonged procedures and Principles of surgery respectively) beyond what was previously assessed in the old UK module 4, for example learning outcome 22.14. *"Demonstrate competence in surgical techniques, including ablations and incisions and their closure by methods appropriate to the tissue concerned"*. Discussions on what is appropriate training to address such learning outcomes and how to assess them are ongoing.

Continued professional development and life-long learning

The other area taxing Establishment Licence Holders, Named Training and Competency Officers and Animal Welfare and Ethical Review Bodies at the moment is the requirement for licensees to undergo continued professional development (CPD) and life-long learning. What constitutes CPD and life-long learning? Is it reading animal welfare papers, attending animal welfare conferences, participating in training courses, completing e-learning resources, something else, or all of these? Those e-learning resources that are publically available can be accessed through ETRIS (**www.etris.leeds.ac.uk**), a website that I have developed that directs individuals to free, open access e-learning resources across the spectrum of laboratory animal sciences. Updates to the site are provided via Twitter (@ETRIS_Leeds). With regard to CPD courses, there are very few relevant ones on offer, one example being the FRAME Experimental Design course. Some Pharma and Universities run in-house courses but these are few and far between. With this in mind, the Animal Welfare & In-Vivo Pharmacology Sub-Committee would like to hear what colleagues/Institutions are doing, to share examples of content, good practice and resources. If you have anything to share, please contact me(**d.i.lewis@leeds.ac.uk**).

Looking beyond the UK to the rest of the EU, how individual member states provide education and training for laboratory animal personnel is being shared on a new website, ETPLAS (Education and Training Platform for Laboratory Animal Sciences **http://www.etplas.eu/**). Content at the moment is limited, the site is under development, but this should grow with time.

These changes to the education and training of colleagues who use laboratory animals for research or educational purposes, and how these are assessed are welcomed by the Society. They are also very much a work in progress, and we will continue to update you.

About the author

Dave Lewis is the Chair of the Animal Welfare and *In-Vivo* Pharmacology Sub-Committee, a Senior Lecturer in Neuroscience and Scientific Ethics at the University of Leeds and a member of the Universities Training Group (UTG) Assessment and QA committee. He is one of the UTGs representatives on the three UK Accrediting Bodies working party which is developing the new modular assessments.

Meetings update

Barbara McDermott, Vice President – Meetings
Talja Dempster, Head of Meetings & Events

Past meetings & events

President's Lecture

The Society's President's Lecture took place on 17 November and was attended by one hundred people: a mix of invited guests and members. The lecture was delivered by Sir Salvador Moncada and was entitled "Pharmacology and the understanding of vascular biology: the last 45 years and looking to the future". Managed with great virtuosity, the lecture took the audience on a journey from the discovery of nitric oxide and its role in the cardiovascular system through to novel strategies based on NO for cancer prevention and treatment.

Pharmacology 2015

Pharmacology 2015 in numbers

Registered attendees: **1,080**
Exhibitors/Sponsors: **20**
Posters presented: **331**
Oral communications presented: **63**
Countries represented: **48**
Oranges successfully peeled: **56**

Pharmacology 2015 saw just under 1,100 attendees descend upon the QEII Conference Centre in London on 15–17 December for three days of scientific talks, posters and networking. Delegate feedback about the event has been incredibly positive with an overwhelming 97% of survey respondents being satisfied or more than satisfied with the scientific programme.

We have received some really constructive feedback about content for future years as well as small improvements that can be made to ensure the attendee experience is as good as possible. Meetings Committee has discussed these suggestions and will endeavour to address them for Pharmacology 2016. A recurring criticism is around the space for posters and exhibitors. Each year a different layout in an attempt to accommodate the increasing number of posters and exhibitors – we're confident we'll find the best layout soon!

A big thank you is owed to attendees, sponsors and exhibitors, symposium organisers and chairs, and reviewers for your collective part in this brilliant meeting.

DMPK 2016

Over a hundred delegates attended the *3rd New Perspectives in DMPK* conference which took place at Burlington House on 8–9 February 2016. The meeting was jointly organised by the British Pharmacological Society, the Royal Society of Chemistry Biological and Medicinal Chemistry Sector, the Drug Metabolism Discussion Group (DMDG), and the Drug Metabolism Group.

Keynote talks from industry leaders provided global perspectives on how DMPK can bring value to the process of informing drug discovery. Topics including the *Evolution of DMPK sciences and drug design, Understanding the role of transporters, Selective metabolism for improved targeting of therapies, Chemical reactivity and in silico approaches across DMPK and Medicinal chemistry drug design* were discussed during the two day meeting, to name just a few.

The award for best 'flash' presentation, was made to Fillipa Antunes (Albumedix) for an elevator pitch of her poster *"New pre-clinical model for studying and optimizing the pharmacokinetics of albumin-linked drugs"*, whilst poster prizes were awarded to Peter Bradshaw (Imperial College London) and Amanda Race (University of Bradford), who each received recent DMPK book titles, kindly provided by RSC Publishing.

Prizewinners' presentation with conference organiser and DMDG Chairman Peter Kilford. (l-r) Pete Bradshaw (Best Student Poster Prize), Amanda Race (Best Poster Prize), Peter Kilford, Filipa Atunes (Best "Flash" Presentation).

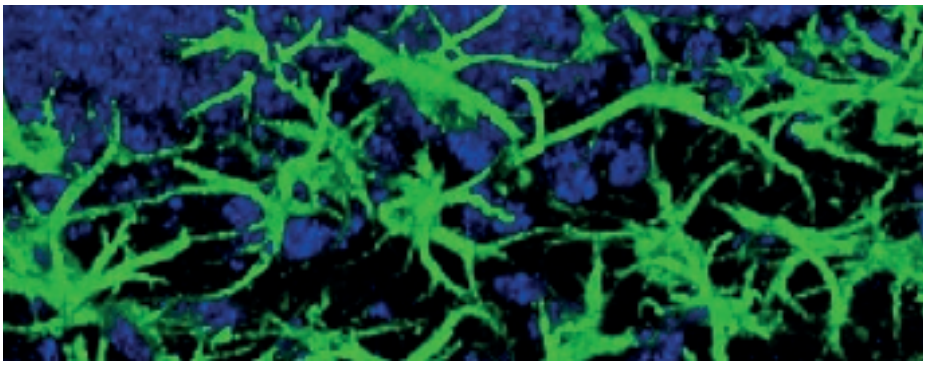
Upcoming meetings & events

Experimental Biology

Members attending Experimental Biology, taking place in San Diego from 2–6 April are invited to visit the Society's stand (#1810) in the exhibition area to say 'hello'!

In addition, there will be a joint networking event at 5.30-7pm on Sunday 3 April hosted by the Biochemical Society, the British Pharmacological Society and The Physiological Society.

Cell Signalling



The 6th Focused Meeting on Cell Signalling will take place on 18–19 April 2016 at the University of Leicester. Abstract submission has now closed but registration is still open – you can register up until 8 April.

In addition to talks from an international speaker line up, the event will feature the 2016 Paton Memorial Lecture presented by Professor Michel Bouvier. More information is available on the Society's website at **www.bps.ac.uk/cellsig**.

European Congress of Pharmacology

The Society's Affinity Groups will be hosting two symposia at the upcoming EPHAR European Congress of Pharmacology in Turkey, taking place on 26–30 June. The symposia are entitled:

- **Molecular and Cellular Pharmacology Affinity Group**: Small molecules inhibitors of ion channels in chronic pain states
- **Neuropharmacology Affinity Group**: Trace amine associated receptors (TAARs): a promising target for pharmacotherapies?

More information on the other symposia taking place at the meeting can be seen on the congress website: **http://www.ephar2016.org/**

International Narcotics Research Conference (INRC)

10–14 July, Bath Assembly Rooms

The provisional programme for the meeting is now available on the Society's website. There will be a full programme of science from Monday-Thursday including plenary lectures, symposia on opioid receptor structure, receptor regulation and crosstalk, neuronal plasticity, pain, craving and addiction, emotional disorders andthe immune system, as well as poster sessions.

Registration and abstract submission are now open, as are applications for bursaries.

New Insights in Inflammation

27 July 2016,
University of East London

This meeting concentrates on the latest concepts in inflammation, giving centre stage to the cutting edge research being carried out by young scientists. Themes such as innate immune cells, inflammation and degenerative diseases, the resolution of inflammation and metabolomics will be welcomed. The meeting topic has deliberately been made wide in order to enable early career researchers to present their work in a series of oral communication and poster sessions dedicated to them. It celebrates the 50th Anniversary of Pharmacology at the University of East London, where inflammation and immunity has been a core research topic since the pioneering work of Dr GB West regarding histamine and mast cells.

Pharmacological aspects of microvascular cell-cell signalling and CVS disease

21–22 September 2016,
Magdalen College, Oxford

Over the last few years there has been a dramatic increase in our understanding of the mechanisms by which endothelial cells signal to control the diameter of the resistance arteries of the body. In particular, there is growing recognition that endothelial cell projections serve as critical signalling hubs, which are subject to disruption in cardiovascular disease models such as hypertension and diabetes. This focused meeting will provide a forum for pharmacologists, physiologists and other vascular biologists with a particular interest in identifying novel therapeutic targets to address the endothelial cell dysfunction that is a feature of cardiovascular disease. The meeting will provide scope for early career researchers to contribute fully through discussion, poster presentations and selected oral presentations.

Pharmacology 2016

13–15 December 2016, QEII Conference Centre, London

We are delighted to announce that Pharmacology 2016 will feature joint symposia between the Society and the American Society for Pharmacology and Experimental Therapeutics (ASPET), the American Society for Clinical Pharmacology and Therapeutics (ASCPT) and the Chinese Pharmacological Society (CPS). In addition to proposals from these three very active sister societies, we received an additional 32, bringing the total to 35, an increase on the 31 submissions for 2015.

To accommodate the growing number of proposals, we are excited to announce that we will be introducing a fifth track to the meeting, so that 15 symposia and an additional 18 oral communications can be scheduled.

Pharmacology 2016 will take place on 13 – 15 December at the QEII Conference Centre in London, so please place that date in your diary now – it's sure to be an excellent meeting! The draft programme is being developed as we go to press and will be available on the BPS website as soon as it is complete.

Proposing a topic for future meetings

If you would like to propose and run a meeting in the future please visit the Society's website: **https://www.bps.ac.uk/propose**.

We are looking forward to a busy few months ahead and hope to see you at one or more of our upcoming meetings this year.

For further information and updates about the Society's meetings & events calendar, please visit **www.bps.ac.uk/news-events**
Contact **meetings@bps.ac.uk**.

BRITISH PHARMACOLOGICAL SOCIETY

TODAY'S SCIENCE TOMORROW'S MEDICINES

Save the date

PHARMACOLOGICAL ASPECTS OF MICROVASCULAR CELL-CELL SIGNALLING AND CVS DISEASE

21 – 22 September 2016 | Magdalen College, Oxford

Upcoming British Pharmacological Society meetings and workshops

- **6th Focused Meeting on Cell Signalling**
  18 – 19 April 2016 | Leicester
- **Ion Channels Workshop**
  1 June 2016 | London
- **Statistics Workshop**
  6 June 2016 | London
- **International Narcotics Research Conference (INRC) 2016**
  10 – 14 July 2016 | Bath
- **New Insights in Inflammation**
  27 July 2016 | London
- **Drug Discovery Workshop**
  6 – 7 September 2016 | Edinburgh
- **General and Advanced Receptor Theory Workshop**
  12 – 13 September 2016 | Liverpool
- **Pharmacological aspects of microvascular cell-cell signalling and CVS disease**
  21 – 22 September 2016 | Oxford
- **Pharmacokinetics and Pharmacodynamics Workshop**
  25 – 26 October 2016 | Birmingham
- **British Pharmacological Society's President's Lecture**
  17 November 2016 | London
- **Pharmacology 2016**
  13 – 15 December 2016 | London

To register your interest and for further information about any of these scientific meetings and workshops, please contact **meetings@bps.ac.uk** or visit **www.bps.ac.uk/news-events**

www.bps.ac.uk
info@bps.ac.uk