

Postgrad study

Is it time you pursued
a higher-level degree?

Plus: widening
participation
for students
with disabilities





PHOTOGRAPH: DOMINIC LIPINSKI / PA

The £6,848 question

As students face mounting debt, can targeted funding for postgrads increase social mobility, asks **Seb Murray**

The benefits enjoyed by those with postgraduate qualifications are becoming increasingly evident. Research published by the Sutton Trust education charity suggests that in Britain, they will earn on average 14% more than those with an undergraduate degree alone. They are also 15% more likely to be employed full-time after six months, according to the Higher Education Statistics Agency, and more likely to use skills acquired during their education in their work.

But with undergraduate tuition fees now capped at £9,250 a year, mounting debt could deter potential students into postgraduate study, which raises questions about the economic barriers some face. Around three-quarters of those on taught postgraduate programmes in the UK - which cost on average £6,848 - are self-funded, with many relying on financial support from their families to pay their fees.

"It is no longer enough to have a bog-standard bachelor's degree

to distinguish yourself from the crowd. Postgraduate qualifications are often essential in many fields such as journalism, and they command a wage premium - £200,000 more than an undergraduate degree alone over a lifetime," says Lee Elliot Major, chief executive of the Sutton Trust.

"But with undergraduates racking up average debts of £50,000, those who do not come from privileged backgrounds and cannot rely on the bank of mum and dad, are prevented from pursuing postgraduate education - the new frontier of social mobility."

Those from under-represented minority groups are the most likely to want to study at postgraduate level but the least likely to do so. Therefore, many universities are now in a multi-million-pound drive to equalise opportunity. In 2017/18, Russell Group universities will spend more than £250m on scholarships, bursaries, fee waivers and outreach to widen participation in education.

However, pleas for a means-tested postgraduate loan system - in which funding is prioritised for those most in need of it - are often ignored, says Elliot Major. "Rather than levelling the playing field, financial aid is too often a vehicle for people who are already advantaged to cement their place in society," he says.

The University of Sheffield

Postgraduate funding Loans, fees, scholarships

- From 2016/17, non-means-tested loans of up to £10,000 have been available to postgraduate students living in England and some EU students taking master's courses at UK universities. These are subject to an interest rate of the RPI (retail price index) plus 3%. Repayments are set at 6% of any income over £21,000.
- The government will be introducing loans of up to £25,000 for doctoral students from 2018/19.
- Around 35% of postgraduate students have used their own savings to pay towards their fees. About 22% used formal loans, 19% had loans from family or friends, and around 10% used fee waivers such as scholarships.
- Young people from working-class backgrounds are only 28% as likely to obtain a postgraduate degree as their peers from privileged upbringings, with high fees deterring many. **SM**

Sources: Higher Education Funding Council; White Rose University Consortium; University of York; London School of Economics

“Education is key to improving social mobility”

provides postgraduate students from under-represented groups with scholarships of £10,000, with awards based on criteria such as whether they are from deprived areas. Last year, the university awarded 154 scholarships - worth more than £1.5m. "It is vitally important that we tear down financial barriers to postgraduate study and widen access to people from all backgrounds," says Wyn Morgan, vice president for education at Sheffield. "Education is key to improving social mobility. A postgraduate degree can provide a huge boost to your employment prospects."

Scott Walker, 25, thought he could not afford a postgraduate qualification, being from a low-income family. But a scholarship from the University of Warwick - which awards 100 scholarships of £5,000 to under-represented groups each year - paid for him to study an MSc in advanced mechanical engineering.

Since graduating last year, Walker has received job offers from leading postgraduate employers including Jaguar Land Rover and Aston Martin, where he works in Milton Keynes as a senior quality engineer. He says the funding was "fundamental to my success".

Artificial intelligence

Master of machines

AI is everywhere - and a broad range of industries want postgrad experts, says **Helena Pozniak**

Intelligence is no longer exclusively human. Machines can now recognise a human face, drive a car, beat a chess master and cope with uncertainty. To be as clever as a human, a system must make the right decision in complex and changing conditions - swerve to avoid someone while not knowing if it's safe, for example, or understand loosely worded commands.

Expectations of what artificial intelligence (AI) can do run high, and universities are keen to meet the needs of industry. Cheaper hardware and software and an abundance of data have fuelled interest. The scope is broad - and a range of master's now offer study

in robotics, neuroscience, linguistics, music perception, visualisation and fuzzy logic.

"I believe AI will dominate computer science for the next 20 years," says Prof Hani Hagra, director of the Computational Intelligence Centre at the University of Essex, which offers an MSc in AI and other associated courses such as computational finance.

Many of his students come from a financial background - AI can be useful in assessing risk and fraud and making sense of vast amounts of data. Learning the discipline makes them highly employable, says Hagra, and the same can be said for other sectors such as health, gaming and the automotive.

Essex runs crash courses to open up AI for non-computer scientists. "Many courses touch on AI but don't have it in the title - robotics, for example," Hagra says. "It's a hot topic in the games industry - many use AI even though they may not call it that."

Most courses want a computer

Humanoid robot NAO Next Gen by Aldebaran Robotics Getty



science degree, and they are competitive - the University of Manchester's MSc in AI is often oversubscribed, but may make exceptions for science graduates with professional programming experience. "But we try to give students the broad perspective," says Manchester's Prof Uli Sattler. "AI means more than just machine learning."

At UCL, AI master's students will be taught some of the course by experts from DeepMind Technologies, a Google subsidiary famous for creating AlphaGo. Last year, the program beat the reigning champion at the ancient and complex Chinese board game Go - a feat experts believed was a decade away.

Nearby, Imperial College's specialist master's is open only to students with a solid background in computing. The course is broad - cognitive robotics, computational finance and more. One of the longest established centres for AI is based at the University of Edinburgh. From here postgrads go on to work in a variety of specialisms, from fraud detection software to spacecraft control. Car manufacturers, finance and healthcare all have openings for AI specialists.

"It's a huge field, moving very, very quickly," says Hagra.

'AI accelerates the search for new drugs'

PhD research student **Sam Cooper**, explains how AI can improve the way we treat cancer

Examining images and data is time-consuming and relies on the judgement and skills of highly specialised experts. Here, artificial intelligence (AI) - or deep learning - can save vast amounts of time and give much more accurate results. We're using deep learning to try and improve cancer diagnosis, as well as accelerate the search for new drugs against cancer.

Using AI, a system can look at a tumour biopsy and diagnose what type it is. Algorithms generally give a more accurate diagnosis as they are unbiased and can pick up on subtle features that are often really difficult to spot with the human eye. As well as exploring how AI can be used in diagnosis, we're also using it to speed up the search for new treatments.

When trying to find new drugs, researchers typically must process and search thousands of images, which can take months of work. With these new techniques, we will potentially be able to get results in a day or two.

I started by studying biochemistry at undergraduate level and went straight into research after my degree. I'd been to an inspirational talk about the potential of AI and I was hooked. Although I didn't really know much about it, when I saw this research position advertised, I jumped at it.

I've always loved maths and computer programming as a hobby - I used to try and make my own computer games. Now this project has allowed me to take a quantitative approach to studying biological systems, my research is cross-disciplinary. Many researchers are beginning to enter the field of AI - you don't have to be a thoroughbred mathematician. But you need a good understanding of how to use AI to solve problems.

Recently I've been over

"I believe we could see the end of cancer in our lifetime"

in Toronto with a view to helping found a new startup. We're at the early stages, but using this technology we want to automate the analysis of biomedical images, whether it's for assessing drug effects or diagnosing cancer. We're initially focused on automating parts of the drug discovery process.

Scientists have been looking into the potential of deep learning for years - you get the sense that we're on the verge of scientific breakthroughs linked to the technology and there seems to be a lot of investment and interest in the field.

There are really good things happening around research into cancer - there's a chance to make a real difference. I believe we could see the end of cancer in our lifetime.

Interview by Helena Pozniak

Sam Cooper, 24, is in the final year of his PhD in cancer research at the Institute of Cancer Research and Imperial College, partly funded by Stand Up To Cancer, a joint national fundraising campaign from Cancer Research UK/Channel 4.



PHOTOGRAPH: JAMES CANNON FOR THE GUARDIAN

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Learn on location

As an EU citizen, options for cheap or free postgrad courses and funding opportunities are plentiful, despite Brexit, says **Lucy Jolin**

It's not too late to beat Brexit and study for a postgraduate qualification in Europe. The benefits are huge and employability is a big factor. "The European Commission's Erasmus Impact Study showed that the share of employers across Europe who consider experience abroad to be important for employability nearly doubled between 2006 and 2013, from 37% to 64%, and this is set to rise," says Naquita Lewis, higher education lead, Erasmus+ UK National Agency.

Postgraduate study in Europe can be considerably cheaper. If you're a citizen of an EU country, you'll only have to pay what citizens of your chosen university's country pay. Fees range from entirely free (Austria, Denmark, Norway) to reasonable - between €200 (£177) and €650 in France, or €1,350 to €1,500 in Spain.

Language isn't an issue, either. The majority of countries in Europe offer programmes taught in English, with the majority in the Netherlands - 12 universities with 1,034 English-taught degrees, including 930 master's. Applying directly to an EU university is easy: just find the relevant contact on the university's website and take it from there.

The Erasmus scheme is still very much a potential source of funding. "We cannot speculate on any possible future scenarios following the UK's exit from the EU, but we note the government position that UK participation in some EU programmes 'promoting science, education and culture' may continue subject to the negotiation," says Lewis. "While we are a member of the EU, UK students should carry on applying and taking part."

Postgraduate students can apply for an Erasmus+ master loan to help with their living and tuition costs when studying in a country other than where they live or where they took their first degree. And the scheme doesn't just provide funding - you can also apply



PHOTOGRAPHS: ALAMY

“We don't travel to escape life, we travel to find life”

to study on an Erasmus Mundus joint master's degree (EMJMD), an integrated, international study programme jointly delivered by a consortium of higher education institutions. You'll study in at least two countries in Europe and may also have the chance to study outside of Europe.

It's also possible to study in Europe while still being affiliated to a UK university. The University of Kent, for example, has four specialist postgraduate centres in Brussels, Rome, Paris and Athens (as part of the Brussels School of International Studies).

"There are numerous benefits in terms of travel, experience, personal development, language skills and more importantly, a focus on the integration of place and academic subject," says Prof Jeremy Carrette, dean for Europe. "For example, the Brussels School of International Studies has access to all the political agencies in Brussels for internships and experience visits, speakers visits and so on."

Europe is still very much open to UK postgrads. "People are brought up in a very strongly connected world," says Carrette. "We don't travel to escape life, we travel to find life. I think that's what an education in another country can help to do."

Kate Pemberton
‘I like being part of an international community’

Kate Pemberton, 24, spent a semester of her undergraduate anthropology and international relations degree at the University of Copenhagen. She loved it - so when it came to choosing a master's, the city was her first choice.

"It was exactly the kind of master's I wanted to do, and I love living in the city," says Pemberton (below), who is now three months into her master's. "In terms of studying, it's a lot more focused on group work and collaborating with other people. I like being part of an international community."

As well as wanting the experience of studying abroad, the absence of fees was a big factor. As an EU student, it's not only free for her to study a master's in Denmark, but she's also eligible for a government grant, available to those who work 10 to 12 hours per week. "It wasn't a deciding factor, but it was a big help," she says. "I don't know how long the situation regarding fees is going to last, but I'm hoping to have finished by the time Brexit kicks in."

Pemberton feels the experience of studying abroad has given her valuable skills. "I've been learning Danish, which isn't the most useful language, but I think any language is a bonus on your CV," she says. "Plus, employers want what moving abroad and living in a different country gives you - you become more adaptable and can survive in stressful situations. It makes you more resilient and you open yourself up to more opportunities." **LJ**

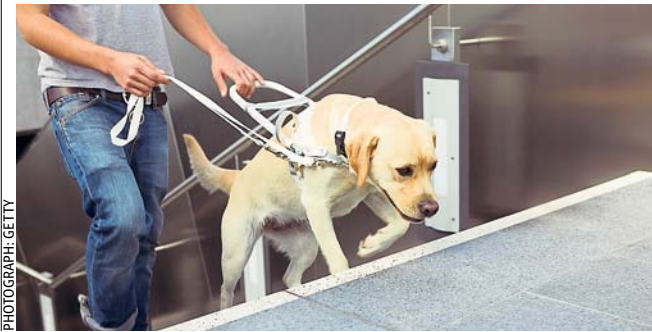


Access all areas

Tighter laws and trained staff help to widen participation for students with disabilities, says **Lucy Jolin**

The number of people with a declared disability in postgrad study has doubled over the last 10 years, according to recent statistics from the Higher Education and Funding Council for England (HEFCE). What's changed - and what do higher education providers still need to improve?

"To some extent, the trend of more disabled students undertaking postgraduate study since 2005 simply reflects the shift to a more supportive and inclusive learning environment that began with the 'widening participation' agenda in the late 1990s," says Tony Stevens, fundraising manager at Disability Rights UK (DR UK). "This was propelled by successive



PHOTOGRAPH: GETTY

Conservative and Labour government policies, including the Labour target of increasing participation in higher education to 50% by 2010."

Providers are now more aware of their legal duties - disability discrimination laws have been strengthened, leading to amendments to the Disability Discrimination Act in 2001 and the introduction of the Equality Act in 2010.

Most universities now employ trained professionals who have worked with students with all kinds of impairments. There is less of a stigma, as well, says Stevens. "In recent years, disability support departments have become more integrated into wider student services."

People with disabilities, Stevens

advises, should start their search in the same way as people without disabilities: think about course subject and type, and funding - then visit, and ask questions around your particular needs.

Of course, barriers to participation still exist for students with disabilities. One big challenge, says Stevens, is careers advice. "We believe that careers advice for disabled students and support to transition into employment is an area that providers still need to improve. Unfortunately, some disabled graduates are tempted to stay in education because they can't get a job, but they haven't researched whether postgrad study will help them get the job they want. In some cases, work experience may be a better way for them to get the skills they need."

On the whole, Stevens says that DR UK views higher education as "a relative success story. Few colleges and universities nowadays would seriously think of refusing a place to an applicant simply because of their impairment, and most have well developed systems and procedures for making sure disabled students progress in their studies."

Visit disabilityrightsuk.org for more info.

Martin McLean 'A PhD supervisor found out I was deaf, and cancelled the interview'

Martin McLean, 38, has two postgraduate degrees - a PGCE awarded by the University of Wales and a master's in arts policy and management from Birkbeck. He's an education and training policy adviser at the National Deaf Children's Society, and has been deaf since birth.



"I took my master's part time alongside working full time, so I needed a university that offered courses in the evening," he says. "That was my priority, rather than a university with a good track record for supporting disabled students. All universities should be accessible to deaf students and the disabled student allowance system for funding support makes this possible."

McLean used a palantypist (someone who types out everything that is said in

class at high speed) and a sign language interpreter for small group discussions or field trips. "Generally, things were OK at Birkbeck, but one lecturer told my palantypist to move as the noise was affecting her. She also told them, from time to time, not to type something controversial she had said. I was annoyed that she felt entitled to choose what I was allowed to understand. It singled me out as different from the hearing students, who had no filter on what was said."

Martin McLean:
'All universities should be accessible to deaf students'
Photograph: Mark Chilvers for the Guardian

While McLean points out that the statistics around more people with disabilities undertaking postgraduate study may not tell the whole story - they also cover those with mental health conditions, which have risen in recent years - he believes that things have got better. In 2001, he was invited to interview for a PhD position at the University of Glasgow. "When the supervisor found out I was deaf, through a reference, he cancelled the interview and emailed me, criticising me for my lack of candour for not telling him about my deafness. Under the law, I didn't have to reveal my disability and I was shocked at such overt discrimination." McLean received an apology but was told that the position was no longer available, as the supervisor had since left the university.

He advises students with disabilities to be proactive in seeking support. "It helps if you are clear about the support that you require rather than leaving it to other people like disability advisers or DSA assessors to decide what you need," he says. "Much postgraduate study involves independent research and writing it up, so make sure you think about your needs outside of class and the lecture environment." **LJ**

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How to ace the application

The trickiest part about the application process for a postgraduate degree, is making the choice to study in the first place. So seize the moment, says **Helena Pozniak**, and the rest is easy

How difficult is it to apply for a postgraduate degree? Returning to education, paying substantial fees and giving up evenings or weekends to study requires commitment. But a postgraduate degree can open a door to a new job, or give a career a facelift. Many people simply embark upon further study from love of the subject.

Quite the hardest part is deciding to take the initial plunge. It took Melissa Thermidor at least six months to decide - she's just started a master's in media, campaigning and social change at the University of Westminster. She manages the NHS blood and transplant's social media strategy and firmly believes digital communications could be a force for good. "I want to work in communication that makes a difference rather than forcing people to buy something," she says.

She had previously been working in marketing in India, and applied for the course a year after having a baby. To secure her place, she wrote an essay and then completed an hour long Skype interview. "At the time it felt a pain, but honestly, it was worth it," she says. "They want the right people on the course - we really talked through the things we'd be doing - it was helpful to clarify my reasons for studying."

Unlike undergraduate applications, there's no central, deadline-driven process for applying to postgraduate courses. Mostly prospective students apply directly to individual universities and need a good degree - usually a 2:1 or above - in a relevant subject, but universities will make exceptions. "The application process for postgrads is remarkably straightforward," says Prof Valerie Sanders, director of the graduate school at the University of Hull. "Particularly when you compare it with the longer timeframe of the undergraduate process. The best way is to apply online."

The popularity of a course can determine admissions procedures. Hull, for instance, interviews all PhD students and for a few taught master's linked to psychology, music and business. Business schools tend to interview MBA students and top-flight schools ask for the dreaded GMAT - a

“Candidates must demonstrate the ability to deal with change and develop new ideas”

Applying for a postgrad course is surprising simple, often with flexible entry cycles throughout the year Photo: Getty

tough entrance exam. At Alliance Manchester Business School, there are four applicants per place. "For us it's not about being choosy," says Fran Johnson, associate MBA director. As well as a sparkling CV, academic background and references, she says that candidates "must demonstrate the ability to deal with change and develop new ideas".

Most taught master's require a personal statement explaining why a student is interested. The academic departments then usually make the call on whether to accept a student rather than a centralised admissions department - although numbers of students on master's courses tend to be kept much lower than undergraduate classes.

While students can apply at any point in the year, places on a few popular courses get snapped up early and some, such as top fashion or gaming degrees and many at elite universities, are highly competitive.

Applying The lowdown

- Since the introduction of postgrad loans in 2016 (for English students), numbers of students taking a master's straight from an undergraduate degree have risen by more than a third.

- Entry cycles are more flexible throughout the year, though popular courses fill up quickly. Many are offered part-time, and some online.

- Students can apply for up to 10 postgrad courses at a time. Postgrad fairs and open days offer help with choosing. For more advice see ucas.com.

- Ten UK universities use Ucas' online application service UKPASS, mostly used by international students. A centralised system launches in 2018.

- A good personal statement, covering your motives, experience and commitment, is important. Popular courses and business degrees may ask students to come in for an interview.

- Universities will usually let students know within a couple of weeks if they've been successful.



A faculty for freedom

The more we study human trafficking and its associated criminal networks, the more effective the solutions, says **Helena Pozniak**

How do you know if you can trust the man who promises you safe passage to Europe? How did you hear about him? Will you be safe?

Since the body of a Syrian child washed up on a Turkish beach in 2015 and brought the plight of refugees into sharp relief, thousands more have drowned trying to reach Europe. Over the past year, the death rate among people attempting the crossing has almost doubled. This is due to one of the fastest growing black markets in the world: people smuggling is now the third largest business for international criminals - after gun and drug trafficking. The International Organisation for Migration suggest people smugglers to earn about \$35bn (£26.7bn) a year worldwide.

If we understood more about how people smugglers operated - how they sold their services and guarded their reputation - authorities could better deal with the problem, says Dr Paolo Campana, an academic and lecturer from the University of Cambridge who studies communications between criminals.

"Sometimes policies fail because they've been devised with a false idea

So far this year, 2,654 people have died crossing the Med. Last year, an estimated 5,000 drowned, up from 3,700 in 2015 (IOM)

of reality," he says. Human smuggling networks are mostly fragmented and often opportunistic, Campana adds, who has sifted through hours of police interviews, court transcripts and wire tappings of desperate conversations between smugglers after a boat has sunk.

Some smugglers cheat, some seem to care more than others whether their cargo drowns, and some offer premium fast track services. If they are arrested, inevitably someone new fills their place.

Smugglers often lure potential clients through texts, word of mouth and social networks - this year Facebook removed posts by smugglers openly advertising their services. "We try to understand communication between smugglers, what makes them likely to interact, and how smuggling operations are structured," says Campana. But Facebook is just one method used by smugglers to communicate, he adds, which will inevitably be replaced by other means.

Some policies to halt the trade have focused on the wrong part of the journey, says Campana. And naval rescue operations in the Mediterranean, although humanitarian, have backfired tragically. "They have the unintended consequence of assisting the smugglers

by taking the refugees off their hands very close to the Libyan coast - making the 'product' [the trip] a more attractive option, and ultimately, increasing the number of journeys," says Campana. It's the exponential demand from people desperate to migrate which should be targeted, but this, he admits, is easier said than done.

While much of Campana's work involves quantitative analysis - he also teaches statistical methods to map criminal networks - researchers must be careful to retain their humanity, he says. He has travelled to Greece and Sicily to speak to people in refugee camps face-to-face shortly after they've disembarked. He has also collaborated with fellow Cambridge academic Prof Loraine Gelsthorpe to speak to migrants in the UK about their experiences at the hands of people smugglers. "Even though I deal with quantitative analysis, I think it's crucial to speak in person to people to get a feeling of what we are studying," he says.

Such a complex field of study requires a wide range of skills, says Campana. He's a social scientist who's been studying criminal networks and organised crime for a decade. People skills, languages, and a legal background can be useful too. "Data is tremendously important, but needs to be analysed and interpreted correctly. That's why it is important to have a holistic approach, and supplement hard data with deeper investigations."

Criminology and sociology master's often cover organised crime and people smuggling, or there are specialist courses in trafficking, human rights and slavery studies.

Employment

Michele Zarri
'Without the master's degree, I would not be where I am now'

Michele Zarri is a senior policy analyst for electricity transmission at Ofgem

When I left school, I trained as a solicitor in Italy and worked as a legal assistant in the private sector. But I wanted a more international career and saw a master's degree abroad as a good way to change industries. I've always been fascinated by energy and thought it was the right time to work in the sector - climate change is high on the political agenda in the UK, with the government pursuing aggressive renewable energy policies.

I enrolled in the University of Edinburgh's MSc in energy and climate change in 2011. What attracted me to the course was that it incorporated the latest cutting-edge techniques. I studied full-time for one year and

found the programme really enjoyable. I learned about the geoscience behind climate change and renewable technologies that can be deployed to reduce greenhouse gas emissions.

The most valuable aspect of the master's is the network - I am still in touch with some classmates. Many of us work in the same or similar fields and help each other solve work-related problems. An alumnus helped me land my current job as a senior policy analyst for electricity transmission at Ofgem, Britain's independent energy regulator. She



Michele Zarri:
'The most valuable aspect of the master's is the network'

helped me understand what Ofgem was looking for and prepared me for the interview. Without the master's degree, I would not be where I am now.

After graduation, I worked for the Department of Energy and Climate Change, which promotes international action to mitigate climate change. Then I moved to the European Emissions Trading Scheme, a scheme for trading greenhouse gas emissions allowances. I began working at Ofgem in 2014. My team manages the delivery of several billion pounds of investment in offshore wind farms and electricity transmission networks. My job is to assess the cost of the infrastructure. It involves data analysis and negotiation with wind farm developers - the most challenging part of the job.

I plan to move into an economist's role within Ofgem, focusing on competition in the retail energy market. The MSc will become less relevant in that job, but it will still be important to understand the wider sector in which I operate. The industry is driven by government support and policy - exactly what I learned on the master's. **SM**

Are two degrees better than one?

Postgraduate study can help you stand out in the jobs market, but choose wisely, says **Seb Murray**

A growing number of students believe a bachelor's degree is no longer enough to attract the attention of employers when job hunting and are entering postgraduate education to boost their employment prospects. Data from the Higher Education Funding Council shows the number of people taking full-time, taught postgrad programmes surged by more than 16,000 to 90,600 in 2016/17 - a 22% increase, with the figures expected to be even higher this year. Three-quarters of the students are under 25 - suggesting that many went straight from a first degree into a second.

"With almost half of all young people in England obtaining undergraduate qualifications, many are turning to postgraduate degrees to set themselves apart in a very competitive climate," says Nick Hillman, director of the Higher Education Policy Institute - particularly in law, media and medicine. Most postgraduate degrees boost your position in the labour market - and your earnings."

The increase in the number of postgraduate students is also attributable to a new loan system, providing up to £10,000 to help with course fees and living costs. "The introduction of the loans system

“It could be the best investment you ever make - but do your homework”

has made it feasible for people who previously did not have access to funding to stay on for an extra year, such as those from low-income backgrounds," Hillman says.

But are two degrees really better than one? Lluís Bardet Álvarez, 24,

studied a master's in management at the London School of Economics after getting a bachelor's degree in business administration. He says a postgraduate qualification was essential to securing his current job at a consultancy firm in Dubai. "Debt did not put me off as I knew a second degree would make me more employable," Álvarez says. "My undergraduate degree was useful but the postgraduate degree programme was more hands-on and collaborative, with group projects replicating the workplace," he adds.

In addition to the qualification itself, knowing more and having greater expertise in a subject will also help you stand out, says Chris MacRae, head of talent for pharmaceutical company GlaxoSmithKline. "We value postgraduates because they bring a high level of academic ability, strategic thinking, leadership and a global perspective," she says.

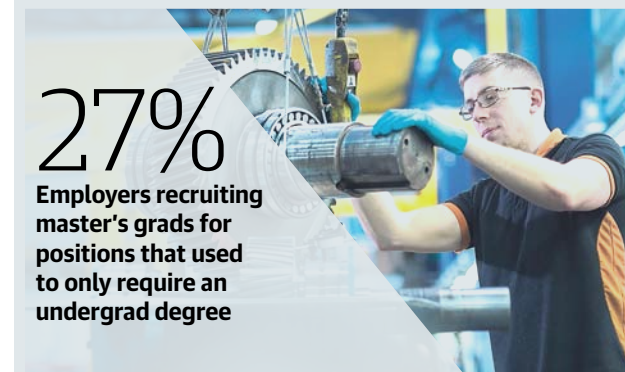
"We employ a large number of postgraduates globally each year, many through our Esprit programme, which is specifically tailored to nurturing postgrad talent. They enter senior leadership positions in all areas of our business, including consumer healthcare, pharmaceuticals, sales, marketing, finance and R&D."

So, is a postgraduate course a guaranteed route to success? Not necessarily, says Alan Smithers, director of the Centre for Education and Employment Research at the University of Buckingham. He warns that students should not assume that a postgraduate qualification will automatically lead to a decent job. "Before embarking on a master's degree, think carefully about whether it will update your knowledge and skills and is relevant to your intended career path," he says.

"It could be the best investment you ever make," he adds "But it won't lead anywhere if you don't do your homework."

Postgrad prospects

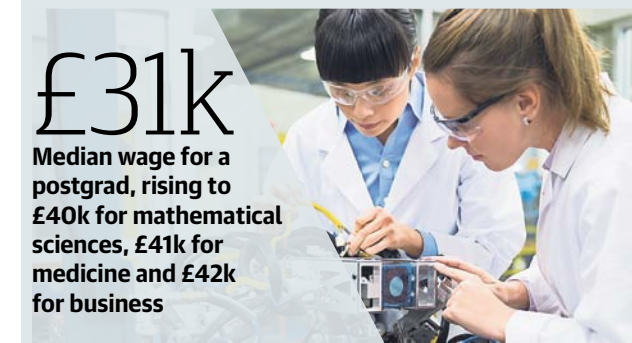
The facts



27%
Employers recruiting master's grads for positions that used to only require an undergrad degree



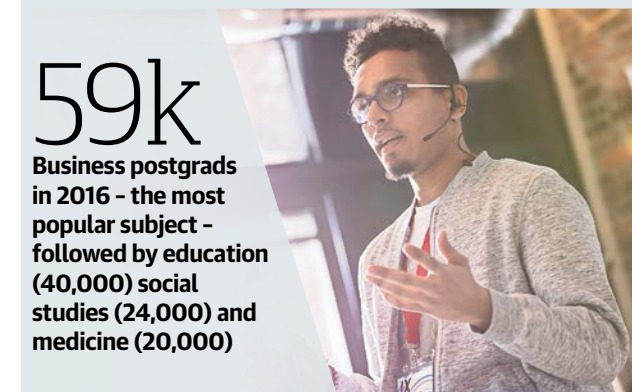
11%
People aged 26 to 60 in the UK with a postgrad qualification, up from 4% in 1996



£31k
Median wage for a postgrad, rising to £40k for mathematical sciences, £41k for medicine and £42k for business



32%
Rise in the number of people obtaining postgrad degrees in the last 10 years



59k
Business postgrads in 2016 - the most popular subject - followed by education (40,000) social studies (24,000) and medicine (20,000)

Sources: Higher Education Statistics Agency; Sutton Trust; CareerBuilder. Photographs: Getty



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A matter of life

With the help of CGI models of placentas, universities are collaborating to investigate why one in five pregnancies end in miscarriage. By **Helena Pozniak**

For an engineer, Dr Michelle Oyen has spent a lot of time with placentas recently. "It's a really weird organ, half baby, half mother. It must begin functioning at the same time as it develops. There's nothing else like it in the body," she says. Oyen is committed to discovering why pregnancies go wrong. And fascinated by applying engineering principles to medical research in her post as reader in bioengineering at the University of Cambridge. "You can't experiment on pregnant women - it's totally unethical and impossible." Instead, her team take high-resolution images of donated placentas to understand the geometry of blood vessels. They then use these to build 3D online models to understand how blood flows around the placenta. "We are trying to understand how cells involved in building a placenta

know how to invade the right amount into a uterus," she says. "They have to get it just right, and it's a poorly understood process." Currently, one in five pregnancies are believed to end in miscarriage, and 85% of these happen in the first 12 weeks of pregnancy. Parents often have no idea why - and it can be heartbreaking for the 200,000 people (women plus partners) affected every year. "I believe some of the problems in healthcare are some of the biggest problems in modern society," says Oyen. "As engineers we have different tools to biologists and doctors. The more people you have approaching a problem from a different perspective, the more likely you are to understand it." Around the country, research collaborations are forming between universities. "There seems to be an

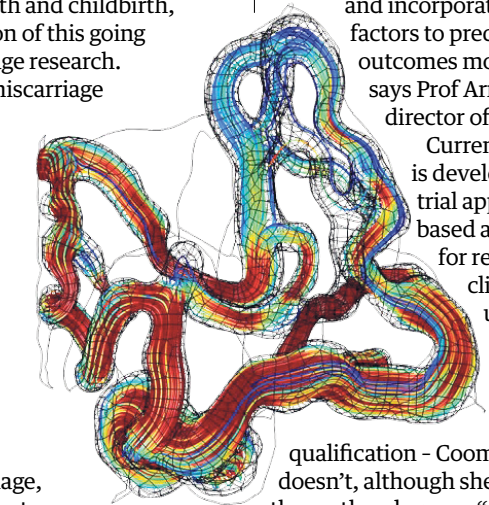


explosion of bioengineers interested in pregnancy," says Oyen. "But compared with other conditions it's been understudied - from a bioengineering perspective at least." In 2013 to 2014, miscarriage research charity Tommy's says that the most up-to-date figures it was able to obtain indicate that just 4% of the government's health research budget was spent on reproductive health and childbirth, with only a fraction of this going towards miscarriage research.

At the largest miscarriage research centre in Europe, hosted by the University of Birmingham, scientists and medics from Birmingham, the University of Warwick and Imperial College London are collaborating to research the causes of miscarriage, stillbirth and premature birth. Tommy's National Centre for Miscarriage, funded by the charity, investigates potential genetic causes, including a possible link to damaged DNA in sperm, and other research avenues, such as the role of bacteria. Using clinical data from

Computer model showing blood flow around placenta villi Image: Romina Plitman Mayo, University of Cambridge

around the country, scientists hope to develop computer modelling that can predict the risk of miscarriage. "We are working to establish the role of the immune system as a prognostic factor in women with recurrent miscarriage, and incorporating these factors to predict pregnancy outcomes more accurately," says Prof Arri Coomarasamy, director of the centre. Currently the centre is developing clinical trial apprenticeships, based at Birmingham, for researchers and clinicians to build up relevant skills. To work in the field, you don't necessarily need a bioengineering qualification - Coomarasamy doesn't, although she does have three other degrees. "All kinds of engineering backgrounds - mechanical, chemical, materials - are perfectly well-suited to the work we do," she says. "The thing about engineering is the tools we bring to the table - such as computational modelling - can be applied to any problem."



Christina Murray 'We're trying to find answers to the big diseases'

Christina Murray is a PhD student researching the causes of Alzheimer's disease at the Queen Square Brain Bank at the UCL Institute of Neurology. Her work, funded by Alzheimer's Research UK, involves using donated brain tissue to investigate the role of the immune system in Alzheimer's disease.

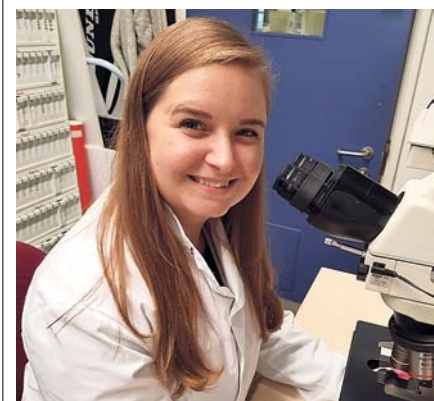
As an undergraduate I originally wanted to study medicine, but I'm glad I did a biomedical science degree instead - at the time I wasn't aware of all the different opportunities it would open up. In my final year I did a lab-based project on neurodegeneration and began to think about a research career. I applied for a job as a lab technician - which I did for four years - and then applied for a PhD.

We work here on donated human brains. I'll look at brain tissue under the microscope, investigating the difference

“If you completed a project at undergrad level, you are probably capable”

PhD neurology research student Christina Murray

in the genes of people with genetic Alzheimer's compared with people who've developed the disease seemingly randomly. Then I'll spend time analysing the data, which involves many hours on a computer. Ultimately we're trying to identify risks of developing the disease. This can be hard work and difficult - you need to be self-motivated and focused. Sometimes you get negative results, but it is worthwhile when you reach the end and have found out something new. We're trying to find answers to the big diseases. There are ways to test out whether you'd like a research career in this field - the Nuffield Foundation can help with mini placements. If you completed a project at undergraduate level, you are probably capable.



Study BME What? How? Where?

● Biomedical engineering combines life sciences and biology with medicine and engineering techniques used to develop implants, prosthesis and devices to help diagnoses and prognosis.

● As an emerging area, there's no definitive entry path or career path. It's an interdisciplinary field incorporating biomaterials, bioinformatics, biomechanics, tissue engineering and more.

● Newcastle, Edinburgh, UCL and Imperial all offer bioengineering as a master's, and some as a research degree (MRes). It can also be specialism in mechanical engineering, medicine and dentistry.

● Edinburgh hosts the Institute for Bioengineering, with research themes including synthetic biology, tissue engineering and biomedical modelling. There are also dedicated bioengineering centres at Surrey, Oxford, Loughborough, Imperial, City, Queen Mary and Leeds.

The imitation game

How biomimetics is replicating nature to create life-changing materials

If scientists could borrow from nature - recreating the strength and elasticity of spider silk for instance - the impact on the environment, manufacturing and medicine would be vast. This is biomimetics - literally copying life - part of an emerging discipline of bioengineering, a subject now offered by many universities at postgraduate level.

Spider silk is stronger than steel on a per weight basis, and doesn't necessitate heavy industrial processes to manufacture. Eggshell is about 97% ceramic but doesn't require the high temperatures needed to make concrete, and hens can make it in about 18 hours. It's the small amount of protein that makes eggshell so tough, say scientists at the department of engineering at the University of Cambridge, where bioengineers are investigating natural materials. While successful replication of spider silk is yet to be mastered, companies in the US have engineered

Spider silk is stronger than steel on a per weight basis Photo: Getty



a lab-grown burger that looks, tastes and smells like real beef.

"Bioengineering is a niche area, and it's quite experimental," says James Hallinan, synthetic biology business developer at Cambridge Consultants, an engineering and tech company that hires postgrads. "Numbers working on it in the UK are only in their thousands. But we are seeing a lot of interest from clients asking about its manufacturing capabilities. If I was a student now it's an area I'd definitely be keen to study."

Hallinan says they are seeing increased interest in the manufacturing side, particularly using sustainable biological material to replace oil as the basis for a whole range of products, from fuels to plastics to industrial chemicals. "Companies such as BP, Shell and Total all have their own

bioengineering departments," he says.

Medical applications are inspiring a different strand of research, Hallinan adds. A new gene therapy treatment, CAR-T, which genetically modifies a patient's own cells so they can attack cancer, was recently approved in the US and was hailed by scientists as a new frontier in medicine. "Another less dramatic but interesting area is being able to manipulate the bacteria in our gut through the food we eat, to improve health," says Hallinan.

UK universities offer a vast range of bioengineering master's with various specialisms, and many have a medical focus. "Bioengineering is a new and emerging area - we use engineering tools to solve healthcare problems, through multidisciplinary collaboration," says Dr Reiko Tanaka, lecturer in bioengineering at Imperial College London. And it's a sector which welcomes a variety of academic disciplines, says Hallinan - from computer science through to molecular biology and biochemistry. "A postgraduate qualification is helpful - it gives you that background in experimental science you might not get at undergraduate level. The sheer scope of opportunities is breathtaking." **HP**