

Get this: PhDs are hard. But PhDs can be hard for the wrong reasons. A recent event held by the RAS's Early Career Network Committee identified a host of unnecessary energy-drains that should be avoided for a more profitable PhD experience. By **Dominic M. Bowman, Fred Richards, Megan Maunder, Áine O'Brien and Douglas Boubert.**

The tensions around PhDs are many and various. It would be lovely if all those tensions were simply matters of the pure cut-and-thrust of academia and research challenges. But the truth is, many tensions arise from the mundane, depleting and often unnecessary travails of university life.

On 16 November 2021, the Early Career Network (ECN) of the RAS organized a career-oriented mentoring workshop focused on 'Getting the most out of your PhD'. Prospective and current PhD students were offered insight into developing their careers and maximizing their experiences as PhD students by four superb panellists and a Q&A session chaired by the ECN's Fred Richards. The event was hosted virtually and attended by more than 50 PhD and undergraduate students, with participants joining not only from across Europe but also from North America, the Middle East and Asia.

Here we summarize the experiences and advice of the panellists and the main themes and topics under discussion during the event.

Is there an optimum pre-PhD career route?

Many prospective PhD students have wondered how to secure a PhD position. The truth is that there is no optimum route; your education and training in the skills needed will always be different to that of other applicants. It also depends on the demands of the project and on what the researcher advertising the position is looking for. But there are certainly specific things that can enhance your chances.

Taking the time to complete a Master's degree (either taught, by research or a combination of the two) can serve as a useful bridge between finishing your BSc and beginning a PhD. Although it is not necessary in the UK, it is more common around the world apart from in the USA. The jump in both level and professional attitude needed in going from BSc to PhD can be extreme and takes its toll on some people; as a PhD researcher you are doing a job, and should treat it as such.

Being incremental and taking your time in your career is fine, because learning how

to transition from being a student to an independent scientist is a gradual process.

Make sure you nurture your passion and interest in your subject. Those who actively seek out knowledge, new skills and collaborators are an asset to a research group. Do not underestimate the importance of being a well-rounded researcher and thinking around and beyond your (often narrow) field. One suggestion is to attend a few taught Master's courses during your PhD to expand your thinking. This is harder to do after your PhD, when spare time becomes increasingly scarce, but that's when you will be expected to have at least a foundation level of knowledge of the wider field. It's your responsibility to achieve this.

When selecting prospective places for a PhD, it is normal to apply to many PhD projects, but you should only choose those where the environment is productive and enjoyable, and the project is genuinely interesting to you. Do not get pulled towards a project because the supervisor is 'cool', but the project is dull. Also, do not be afraid of simply emailing supervisors whose research interests you. It can be advantageous to show initiative and interest in a possible future application; most supervisors value initiative.

Choosing a good supervisor depends on more than their research profile. A successful PhD project is based on the professional working relationship with your supervisor, so choose someone who complements your own personality. This does not necessarily mean a personality that is the same as yours, nor someone who is your opposite; but someone you can work with. It is always worth trying to get in touch with an existing member of a prospective supervisor's group to get an unvarnished impression of team dynamics and the supervisor's character and management style. Remember that this person may be writing reference letters for your future job applications, so choose wisely. Finally, if you want something to happen, for example, your supervisor's opinion on a paper, a job, or a potential collaborator, then ask for it. Do not assume doors will open automatically for you, because academia is very competitive.





How best to manage your work time?

One of the largest concerns of PhD students is finding an ideal work-life balance and managing their daily agendas. There is no such thing as a 'typical' working day as a PhD student, because tasks differ wildly based on deadlines, teaching semesters, and day-to-day (plus last-minute) tasks.

It is very important, especially in the first couple of years of a PhD, to allocate time specifically for reading in your agenda. You'll need, on average, a minimum of one working day per week to gain the basics of your research field. This includes not only recent research papers, but textbooks as well. An often-overlooked source of reference material is PhD theses themselves; find a recent PhD thesis on a related theme, and take the time to digest the introduction chapter thoroughly. You will find an invaluable reference list of sources to introduce a non-expert to the field. Trying to 'find time for reading' is a common complaint further on in an academic career, and often comes to those who do not allocate time in their calendars for this important task. Informal journal clubs with a maximum of about a dozen people are also a good way to learn about jargon and acceptable assumptions in your and others' fields. Senior academics are far more aware than you may realize of the PhD students who have spent time reading and those who have not.

Allocating time to learn and practise new skills such as coding, outreach and preparing presentations is also critical. Many PhD students (and postdocs) do not realize that it takes years of practice to become excellent in giving presentations. Good advice includes setting up an informal 'presentation club' for PhD students and fostering an environment in which it is normal for people to make mistakes in order to learn how to improve. Practising in front of your supervisor can be daunting so having an alternative outlet is useful. Unfortunately, there is little tolerance or patience for senior PhD students or postdocs who are ill-prepared and do not give effective seminars or conference talks. These skills are hard to learn quickly so take the time to invest in your own development from the start of your PhD onwards.

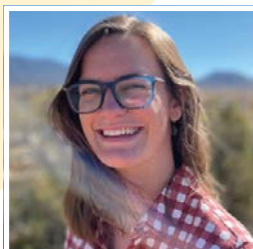
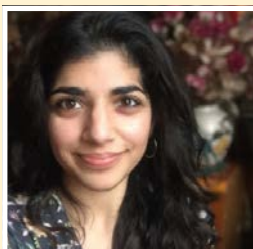
"Asking for help is how everyone learns and improves, and everyone does it, even professors"

Other tangential tasks of a PhD researcher, such as teaching and administrative work, can come to dominate your agenda, so much so that your time available for research is minimal. Therefore, it is critical to block out 'research time' and 'teaching time' as separate events in your calendar and not to deviate or to confuse them. When you are performing research, you can even think of it as setting your email inbox to 'do not disturb', just as you would while you are teaching. Time is your most precious resource; make sure you protect it and use it efficiently.

A common concern among PhD students is how to ask for help without damaging their supervisor's opinion of their work or capability. It is important to realize that you are not alone: many PhD students struggle with asking for help when they urgently need it to make progress. Generally, there are two reasons for this. One, the more common, is that a PhD student is embarrassed to ask for help because they do not wish to 'look stupid'. But asking for help is how everyone learns and improves, and everyone does it, even professors. The second reason is more subtle and potentially dangerous: pride. Some students do not ask for help because they refuse to accept that they need anything from anyone else in order to succeed in a task. Do not become one of these people. Research is a collaborative enterprise, and no one wins if researchers do not collaborate and share ideas.

If you find yourself in the position that you have genuinely tried to solve a problem and are stuck, make sure you ask the right person for help. This is not always your supervisor. For example, asking your supervisor how to print in your new office is a waste of your time (and theirs). Make sure you find out who is the best person to help you solve your problem. The most efficient and productive researchers are almost always the best-connected people because they know and are known by everyone in their department.

Another important and ever-present challenge is saying no. This is a difficult but necessary skill to learn as a PhD student. It can be quite common to be assigned administrative tasks that are not really part of your job description, and PhD students are often too shy or



Our panel

Amery Gratton is a postdoctoral researcher at the University of Oxford, who was a PhD student at the University of Leicester. Previously, Amery studied architecture before completing an MPhys, followed by a year of teaching and a PhD in Theoretical Astrophysics.

"Remember that this is your PhD so you should take control. It is not simply a continuation of your bachelor's or master's degree. Be confident, and drive the PhD in the direction you would like it to go."

Tish Mehta is a final-year PhD student at the University of Warwick who specializes in research on the Sun, as well as being active in outreach and public engagement.

"A PhD is a job, so make sure you spend plenty of time to become a complete and well-rounded person outside of your job as well. You may love your work, but it should not be all-encompassing in your life."

Calum Hawcroft is a final-year PhD student at KU Leuven in Belgium, whose research focuses on the winds of massive stars. Calum was formerly an undergraduate student at the University of Leeds.

"It is easy to underestimate how much time is needed to properly take care of yourself. A PhD should be treated as a job; do not overwork yourself and take steps to make sure you do not burn out."

Sophie Coulson is a Director's Postdoctoral Fellow at Los Alamos National Laboratory (New Mexico, USA) whose research specialism is in modelling flow and deformation in the Earth's interior and its effect on sea-level and ice-sheet stability. Sophie was formerly a PhD student at Harvard University and an undergraduate at the University of Liverpool.

"Networking and building professional working relationships with colleagues are really important for your career, more so than having a beautifully written thesis. Make sure you see the bigger picture of your PhD and how your work fits into the wider scientific community."



polite to refuse. Worse still, such tasks are sometimes labelled as 'important for your training'. We are aware of some senior members of university staff who ask their PhD students to book rooms for them, fix their computers when they break, or, worse yet, bring them coffee, answer their emails, or even perform maintenance tasks at the supervisor's home on weekends. Do not let yourself be exploited. If something feels wrong, or others are telling you 'that's weird', then it probably is. You should seek independent guidance on how to handle the situation from your institution.

During the final year of a PhD, with the submission deadline looming, many students begin to sacrifice their hobbies and social life and spend their waking hours almost exclusively on work. This is dangerous; extracurricular activities matter. They relieve the inevitable pressure, and they re-energize and cheer students up when work gets stressful or a project isn't progressing as fast as had been hoped. Outside interests are also part of what makes you you; jettisoning them is a long-lasting source of regret for many PhD students after they graduate. You may have to scale social activities back as you get close to finishing, but it is

important to retain at least some of them to remind yourself that you are more than just your PhD.

Ultimately, the best outcome is to optimize a working day that works for you as an individual. Coming up with the ideal agenda that balances your commitments takes practice, and guidance from senior PhD students, postdocs and supervisors is useful.

What makes up a PhD timeline?

When you focus on the bigger picture of managing a PhD, advice often turns into statements that are both vaguer and harder to implement. Perhaps the best advice for a PhD timeline comes from one of the founding fathers of the US, Benjamin Franklin: "Failing to prepare is preparing to fail". Being successful during a PhD means agreeing sensible deadlines with your supervisor. The emphasis here is on sensible deadlines, because it can happen that supervisors request unfeasible amounts of work within a given timeframe. It is your responsibility to speak up and say if this is the case. Make sure that you stay in the driving seat of your project.

It is also important to remember that a PhD is a marathon, not a sprint. To sprint is to over-exert



oneself for a very short amount of time. Olympic 100-metre sprinters typically do not even breathe during the race, and rely almost entirely on anaerobic respiration for energy, something that is not sustainable in the long term. As a PhD student, do not forget to breathe and keep enough energy in reserve to see you through to the finish line, like a marathon runner. The last six months of a PhD are usually more stressful than they appear. Do not go into them already running on reserve energy.

The general consensus is that a productive PhD student is one who is able to adapt and be flexible to the ever-changing landscape of research. In some fields, new research results are published every week, which can change the scope and ultimate goal of any PhD thesis. A common mistake is to deal with this mounting pressure by working even harder and setting higher and higher goals. Adapting to your environment does not mean simply working harder. It means changing and re-defining. One poignant example of this problem in academia has been revealed by the ongoing Covid-19 pandemic. It is hard to believe anyone who claims that they have been more productive over the past two years; most researchers have had to adapt and be flexible in how they approach research.

Throughout your PhD, it is important to invest time in developing your CV and boosting your international mobility and networking. These also take time to develop, so do not leave them to your final year. Part of being successful in academia boils down to 'name recognition': advertizing your work at conferences in the form of talks, posters and networking with collaborators in your wider field is critical. Think ahead and past the end of your PhD, and plan accordingly. If your career aspirations are outside of academia, then make sure you allocate time to developing the necessary skills to transition seamlessly from an academic environment to a job in industry. Having a PhD is a major asset, without question, but it does not automatically open all doors for you, especially if you compare your skillset with someone who has spent the past three or four years working in industry after an undergraduate degree. Sell your strengths and bolster the weaknesses in your CV.

How to judge progress and expectations?

A PhD is difficult. So, above all, do not assume that it is going to be easy; you will be challenged. If you are doing a PhD, this most likely means that you are a highly intelligent individual with great potential to succeed in life: congratulations! But you should realize that everyone around you, also doing a PhD, is similarly talented. You are not competing, but you should be aware that some people will try to make doing a PhD a competitive environment. This is a shame, because in order to succeed in your PhD, you do not need to ensure that others lose.

If you are in need of reassurance, in most cases your peers and your supervisor can help, the former for more casual questions and the latter for important discussions. But do not wait for unsolicited advice from your supervisor. Make sure you keep track of your own timeline and have regular (i.e. at least every six months) meetings that are specifically and solely about your progress along your PhD timeline, and not about the work itself. This will help you (and your supervisor) to plan the remaining time and your future career more efficiently. A major benefit of these reflective meetings is that they help to manage everyone's expectations and ensure a constant open dialogue between you and your supervisor.

A tough lesson to learn, but learn it we all must, is that everything takes longer than you think to complete. From answering a short email to writing the thesis, it is remarkable how good humans are at underestimating the time it takes to complete a task.

Named after the legendary chief engineer Montgomery Scott from the TV series Star Trek, the 'Scotty Factor' is the number of times you should multiply your initial estimate of how long a task will take to get a realistic estimate. Surveys and anecdotal evidence put the Scotty Factor for PhD students in astronomy and geophysics between 3 and 5, dependent on the task: higher values for research tasks such as coding and writing papers, and somewhat lower values for preparing teaching tasks and presentations. Despite many people being aware of this, we all allocate blocks of time in our agendas that are too short for such tasks, and are then surprised and disappointed by how much longer they take.

On top of these common time-management issues, researchers are often perfectionists who struggle to admit when something is actually finished. The common saying of "a PhD thesis is never finished, it is submitted" applies here. There is always more work and further tests that will reveal tantalizing extra details. This is a great irony of research: if something was ever truly understood, researchers would stop and quickly find themselves unemployed, because there would be nothing left to do. Try to avoid slipping into the habit of polishing everything to the extreme: finish, stop, and move on when the task is complete.

No advice for PhD students would be complete without addressing the elephant in the room: doing a PhD is stressful. Many claim it as the most stressful period of their lives, leaving them with a poor work-life balance, having lost much of the passion they once had for their subject. It should not be normal to be continually under stress during a PhD. Your goal should be to minimize the sources that contribute stress to your work. One common source of stress among PhD students is not being honest with oneself about how to constantly balance the feasibility of the workload and the expectations of your supervisor. And, as soon as you meet those expectations, they are inevitably raised. This is an endless cycle. If you are struggling, it is important to acknowledge this and seek help from your peers, your family, and professional services either affiliated with your university or elsewhere. There is no shame in seeking help. Mental health is generally poor among PhD students, and despite resources being available there is still a stigma around using them; some people feel that admitting that they are struggling in itself constitutes some sort of failure. The ongoing Covid-19 pandemic has both amplified and shone a light on the issue of mental health of PhD students and early career researchers in general. Everyone is generally less productive, less motivated and more stressed. It is important to create space for yourself and avoid burnout.

Finally, remember that behind every computer screen and lab coat is a human being. In particular, despite improvements in recent years, astronomy and geophysics is an environment dominated by male and ethnically white people. For members of minority groups, it is more common to be excluded and overlooked, so remember to be kind and look out for everyone. Most importantly, do not sacrifice your life, hobbies, or friends and family for the sake of your PhD. You may love what you do, but it is not worth losing everything else in your life over it. ●

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The ECN committee trusts the event was beneficial to early career researchers. If you have feedback or suggestions, please get in touch: ecn@ras.ac.uk

