­­**The experience of male and female physics and astronomy doctoral students in the UK**

Members of Council will recall that the RAS Committee on Diversity in Astronomy and Geophysics (CDAG) commissioned a joint study with the Institute of Physics (IOP) on the experience of doctoral students in the UK. The IOP / RAS study is now complete, with the report set to be published pending some additional minor amendments. As Council agreed to support this in early 2014, it seems timely to bring this (near final) draft forward for information.

Once the IOP has completed its internal sign off process, the report and an executive summary will be made publicly available and can for example form the basis of an article in A&G.

Members of Council are invited to read the report and to consider how its findings should shape the activity of the Society.

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**This policy briefing has been prepared by the Institute of Physics (IOP) in collaboration with the Royal Astronomical Society (RAS) for funders and policymakers and those involved in the development and delivery of doctoral courses in the UK. It is based on the results of a survey of the experiences of physics and astronomy PHD students in the UK undertaken in spring 2014.**

1. **Introduction**

This briefing is part of a wider project initiated by the Institute of Physics (IOP) in collaboration with the Royal Astronomical Society (RAS) to look at the overall experience of physics and astronomy doctoral students in the UK[[1]](#footnote-1).

There are around 4000 doctoral students studying physics or astronomy in the UK[[2]](#footnote-2). As well as their research, doctoral students provide a vital source of talent for a huge range of complex industries. Meanwhile a doctorate remains the primary route into academic and research careers in the UK. The average salary of doctoral students from physical sciences seven to nine years from graduation is £40,000 according to RCUK[[3]](#footnote-3). A doctorate remains a route towards a well-paid and productive career.

The findings presented here are derived from a survey conducted by Oxford Research and Development between March and May 2014 and completed by 995 physics and astronomy doctoral students at UK institutions[[4]](#footnote-4). Of those who responded, 70% were male, 22% were female and 8% did not specify. The survey had two primary aims: firstly, to better understand the effects on student experience of the changing landscape of PhD provision in the UK with the recent introduction of Centres for Doctoral Training (CDTs); and secondly, to investigate differences in the experiences of doctoral students from under-represented groups.

This briefing considers findings on the latter aim, providing a snapshot of the differing experiences of male and female physics and astronomy doctoral students in the UK. It includes a set of recommendations that draw on these findings targeted at physics and astronomy departments, funders, and professional societies.

The underrepresentation of women in physics and astronomy is an ongoing issue, and although there are proportionally more women studying towards doctorates than at undergraduate level, they still only make up 25% of doctoral students[[5]](#footnote-5). This restricts the number of women going into an academic career, and there are further challenges with women’s progression in academia, with only 6% of women in academic positions in physics and astronomy becoming professors[[6]](#footnote-6). The gender imbalance in physics and astronomy potentially holds back a significant cohort from using their talent and potential in physics, both in academia and industry. The reasons for the underrepresentation of women in physics and astronomy are a subject being explored and tackled at all levels. But women’s experience of doctoral study in physics and astronomy has been the subject of less focus before now.

1. **Key Findings**

**OVERALL EXPERIENCE OF PHYSICS AND ASTRONOMY PHD STUDENTS**

A clear majority of both male and female doctoral students in physics and astronomy report that they are happy with their doctorate; however, on average, **female doctoral students rate the overall experience of their doctorate lower than their male peers.** Female doctoral students also report far lower levels of satisfaction and across a number of substantive areas related to their doctorate, which in many cases start off at similar levels to male doctoral students in the first year but fall significantly towards the second and third years of study. **For example, the proportion of female doctoral students who are happy with their doctorate drops by 15 percentage points over the four years of their doctorate**. The proportion of male doctoral students who are happy is almost unchanged across the same period. Female doctoral students also report lower levels of satisfaction with departmental culture, and are more likely to perceive a lack of diversity within departments.

**FUNDING**

**Non-British female doctoral students and who were not members of a CDT receive the lowest proportion of funding from UK Research Councils against other funding sources**. Whereas their male counterparts receive around 26.3% of their funding from UK Research Councils, female doctoral students who were non-British nationals receive half of this. This compares to 66% and 61.8% for male and female British doctoral students. In addition, whilst male CDT members receive a wider range of stipends at both the higher and lower ends of the salary scale, proportionally three times as many male CDT members as female receive the highest level of funding.

**DEPARTMENTAL CULTURE**

**There are noticeable differences in attitudes to diversity issues within departments between male and female doctoral students**. While 73% of female doctoral students strongly agree or agree that there should be more female academics, only 52% of male doctoral students hold similar views. Similarly, 45% of female doctoral students and only 29% of male doctoral students agree that a more diverse mix of people and staff in their department would be beneficial. Whilst 70% of male doctoral students agree there was a strong equality and diversity culture in their department, only 58% of female doctoral students did.

**Female doctoral students’ relationship with their main supervisor appears to deteriorate more over the course of their doctorate compared to their male peers**. Only 70% of female doctoral students in their fourth year rate their relationship as good or excellent (above average) compared to 93% in their first year of study. Among male doctoral students, the figures were 85% and 91% for fourth and first years respectively.

**CAREER PATHS**

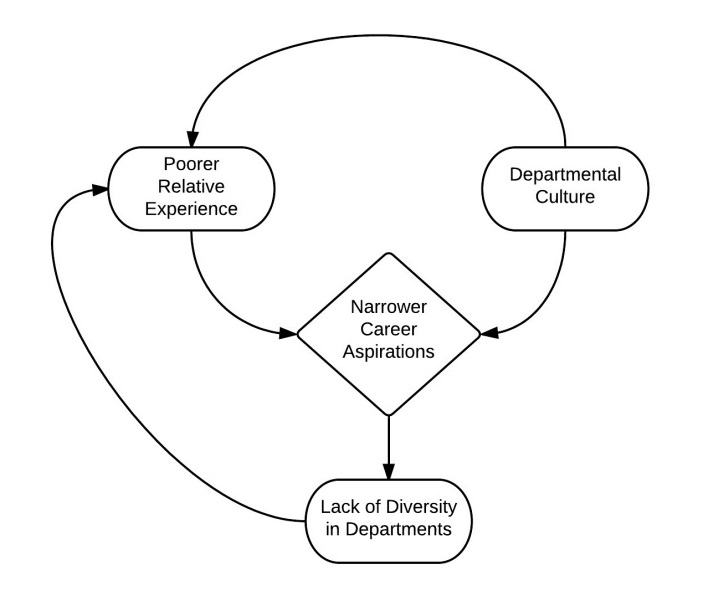
****Despite reporting as much confidence in their technical, transferable and general skills as their male counterparts, **only just over half (55%) of female doctoral students agree that they would make good research scientists, with the proportion agreeing dropping as low as 46% in the third year**. In contrast, male doctoral students remain consistently confident that they would make good research scientists throughout their doctorate, with 70% overall agreeing on average across all years of study.

Figure 1: Female doctoral students’ experience of their doctorate within a feedback loop

The survey reports a significant decline across the four years of a doctorate in female doctoral students’ expectations of a research position, while male doctoral students’ expectations remain stable and relatively high compared to the number of positions available[[7]](#footnote-7). When asked if they envisaged that they might have a university role in 3 – 5 years’ time, in the first year 78% of male doctoral students feel this is likely compared to 65% in the fourth year of study. In contrast, **82% of female doctoral students in their first year share these expectations, falling to 48% in the fourth year**.

As can be seen in Figure 1, each of these aspects may have a relational effect on another as part of a feedback loop. For female doctoral students, overall satisfaction with their doctorate declines more quickly than male doctoral students, whilst their confidence that they would make a good research scientists seems to fluctuate considerably across the years of their doctorate. Female students report fewer meetings with their supervisor as their PhD progresses and their expectations of a research position in the future decline. These changes in career expectations are likely to have an effect on the diversity of departments, as lower numbers of female doctoral students choose to pursue a career through academia. Finally, the lack of diversity within departments may have a negative impact on female doctoral students’ overall experience.

1. **Key recommendations**

*Departments should:*

* Scrutinise the support provided to doctoral students, particularly female doctoral students, to avert falling levels of satisfaction during PhDs, including regularly collecting feedback, including students in departmental decision-making and working more closely with students to assess skills and career options.
* Provide closer monitoring of doctoral students’ career intentions across their degrees through dedicated, continuous and consistent CPD; provide opportunities for female doctoral students to formally network with one another and women in science and academia.
* Working closely with equality and diversity/Juno committees, provide training on unconscious bias for all staff and students, including highlighting its effects on diversity within departments; include doctoral students on equality and diversity/Juno committees.
* Develop mechanisms to ensure closer scrutiny of doctoral students’ relationships with supervisors and take measures to ensure greater transparency in the level of support offered.
* Improve the access to and quality of information on doctorates for applicants, particularly for those students entering a new institution.
* Explore ways to address the significant minority of doctoral students who report feeling socially isolated, by looking at ways to improve departmental cohesion and promotion of social activities.

*Funders should:*

* Ensure policies are in place to provide equal and equitable access to funding sources to address disparities in funding between male and female doctoral students.
* Investigate the reasons behind the lower levels of funding for female overseas students.
* Explore ways to provide greater funding for courses to prepare doctoral students without a postgraduate master’s qualification for the rigours of doctoral research.
* With departments and professional societies, explore ways of financing improved and impartial careers advice for doctoral students in order to improve the knowledge of and aspirations towards a range of relevant careers.

*Professional societies should:*

* Work with departments and funders to develop improved and coordinated impartial careers advice from undergraduate to PhD level to ensure students have access to the best possible information on their choices and to make more informed decisions.
* Working closely with Juno/equality and diversity committees, assess the needs of female doctoral students and provide dedicated support, such as mentoring, networking sessions and bespoke careers advice to improve satisfaction and widen career aspirations.

1. **Summary report**
   1. **Candidates’ background**

The survey results show a clear difference between male and female doctoral students with regards to their prior work experience. While 40% of male doctoral students gained experience via a work placement as part of their previous degree, only 28% of female doctoral students did. However, 83% of female doctoral students completed an internship prior to their doctorate, compared to 67% of male doctoral students. Work placements tend to prolong a degree course, and given that higher proportions of female students take BSc courses, it may be that there is a tendency for female students to want to complete their degrees in a shorter period of time compared to their male peers.

Finally, the survey reports that British female doctoral students are more likely than male doctoral students to be studying at a different institution from where they studied for their first degree. While this is true for both physics and astronomy, it is even more pronounced in astronomy, where 74% of female doctoral students are studying in a different institution. A majority of male doctoral students studying astronomy also record that they are studying in a different institution. This may be as a result of there being fewer institutions in which a doctorate in astronomy can be pursued, forcing students to move institution. This survey also finds that astronomy students are more likely to make a decision on moving to an institution based on its reputation in their field, leading them to explore different institutions.

* 1. **Choosing and applying for a PhD**

Doctoral students’ motivations for undertaking a PhD are relatively consistent across physics and astronomy and across genders, with over 60% selecting “*Because I love my subject and wanted to learn more*” as either their main or secondary motivation. Astronomers are more likely than physicists to be motivated by the reputation of the institution or research group than physicists, and far higher proportions of female astronomers chose their doctorate due to a perceived aptitude than female physicists.

The vast majority of students received funding for their PhDs. Amongst those reporting having received funding, female doctoral students were much more likely to receive combined sources of funding, in particular UK Research Council (including CASE awards) or department funding combined with another source. Male non-British nationals received 26.3% of their funding from UK Research Councils, compared to just 13.3% for female non-British nationals. British male and female doctoral students each received around two thirds of their funding from UK Research Councils. No British female doctoral student received solely industrial funding to cover all the PhD costs, compared to 4% of male doctoral students.

There were wider differences with regards to funding for CDT members. Of male CDT members, 12% received funding of £16,000 or over, while only 4% of female CDT members received as much, and none report receiving over £18,000. This has to be balanced with the fact that 9% of male CDT members report receiving less than £12,000, while no female CDT members report receiving less than this figure. While the range of funding received by male CDT members is wider both at the higher and lower ends, the fact that proportionally three times as many male CDT members as female received the highest level of funding is a cause for concern, and reflects the gender pay gap born out in wider society.

Almost half of doctoral students feel that there were ways in which they could have been better prepared for their doctorate, but consistently higher proportions of female doctoral students report that they felt underprepared and that they could have benefited from further training in preparation. A quarter of female doctoral students either disagree or strongly disagree that they felt prepared from their previous studies and experience to pursue independent research, compared to just 14% of male doctoral students. Nearly 50% of those students that did not possess a postgraduate master’s qualification agree that a funded master’s course would have helped them prepare for independent research and that a short research taster course would have helped them prepare, with slightly higher proportions of female doctoral students agreeing.

Female doctoral students are also more likely to feel like they had not received enough information on their doctorate during the application and interview process, with around 42% believing this to be the case against 34% of male doctoral students.

* 1. **Experience whist undertaking a PhD**

Consistently, both in terms of their overall experience of their PhD and through their experience of individual areas, female doctoral students express lower levels of satisfaction in the progress of their PhD. While some of the proportional differences between male and female doctoral students are small, they exist as part of a recurring theme in the data (see Table 1).

|  |  |  |
| --- | --- | --- |
| **Table 1: Selected responses to questions relating to satisfaction by gender** | | |
| **Question** | **Male %** | **Female %** |
| 1. Doctorate met expectations | 68 | 58 |
| 1. Pleased with decision to do a doctorate | 86 | 83 |
| 1. There is little that can be improved about doctorate | 43 | 40 |
| 1. Happy with way doctorate is going | 72 | 65 |

More significantly, female doctoral students’ overall level) of satisfaction (question d. in Table 1) drops from 80% to 66% from their first year to their fourth year (dropping as low as 57% in their third year), while for male doctoral students it drops from just 74% to 72% and remains relatively static across the same years (see Figure 2). Just 3% of female doctoral students in their first year say they are not happy with the way their doctorate is going, but this rises to 15% by their fourth year.

Figure 2: Male and female doctoral students’ response when questioned on how happy they were with how their doctorate was going by year of study

While a majority of doctoral students rate their relationship with their main supervisor as excellent or good overall, students do on average rate their relationship lower as year of study increases. In particular, female doctoral students’ rating of their relationship with their main supervisor drops significantly compared to male doctoral students, with 70% of female students in their fourth year rating their relationship as good or excellent compared to 93% in their first year of study. For male doctoral students the comparative figures are 85% and 91%, respectively.

Overall 57% of male and 49% of female doctoral students report having prearranged meetings with their supervisor. It is notable that the proportion of female doctoral students reporting having prearranged meetings with their supervisor falls from 60% in their first year of study to 42% in their third and fourth years, while the proportion of male doctoral students reporting having prearranged meetings only falls slightly between their first and fourth years. The survey finds a correlation between the likelihood that a student will describe having a positive relationship with their supervisor and having prearranged meetings, and this latter finding may explain the lower proportions of female doctoral students satisfied with their relationship with their supervisor.

* 1. **Departmental culture**

A significant minority of both genders report having felt socially isolated during their doctorate, 30% of female and 25% of male doctoral students. This is a slightly worrying finding, suggesting departments need to do more to integrate students into the department and promote more social opportunities.

Larger proportions of female doctoral students confirm that there is doctoral student representation on their departments’ equality and diversity or Juno committee[[8]](#footnote-8), but a majority express a lack of knowledge - 60% of doctoral female students and 67% of male doctoral students respectively. While the majority of both male and female doctoral students agree that they have been treated as an equal by their fellow students, lower proportions of female doctoral students agree, 83% against 93% for male doctoral students.

Questions surrounding attitudes to diversity within departments overall find a larger disparity between male and female doctoral students. For example, 52% of male doctoral students and 73% of female doctoral students strongly agree or agree that there should be more female academics in their department (see Figure 3).

**Figure 3: How strongly respondents agree with the statement, “*I feel that there should be more female academics*,” by gender**



It is perhaps not surprising to find such a large difference between the responses of male and female doctoral students, and female doctoral students are perhaps more likely to be aware of the gender imbalance in physics/astronomy academic staff and consequently hold stronger opinions. But there is potential in the fact that only 7% of male doctoral students actively disagree. It would be interesting to see whether raising the awareness of the gender imbalance in physics/astronomy will result in a higher proportion of male doctoral students agreeing that there should be more female academics.

Respondents were also asked how strongly they agree that their department would benefit from greater diversity in staff and people, with which 45% of female doctoral students and 29% of male doctoral students agree. Large proportions, 48% of male and 37% of female doctoral students, neither agree nor disagree. Conversely, 70% of male doctoral students agree there was a strong equality and diversity culture in their department against only 58% of female doctoral students.

While a majority agree, a significant minority of female doctoral students, 22%, feel they are not being provided with good role models during their studies. There is an ongoing issue with the underrepresentation of women in lecturer and senior academic positions, and this is likely to be a major underlying cause of the higher levels of female doctoral students not finding good role models throughout their studies.

* 1. **Careers**

In contrast to the pattern of lower overall satisfaction among female doctoral students, when asked whether they are gaining transferable skills, 84% of female doctoral students compared to 80% of male doctoral students agree or strongly agree. Similar majorities of respondents of both genders also agree that they possess the majority of technical and general skills that are often looked for by employers.  
  
However, asked whether they felt they would make good research scientists, just 55% of female doctoral students agree, compared to 70% of male doctoral students (see Figure 4). The proportion of female doctoral students agreeing varies significantly by year, from 65% in the first year of study to 50%, 46%, and 60% in the second, third and fourth years of study, while for male doctoral students the proportions remain relatively stable across all years.

**Figure 4: How strongly respondents agree with the statement, “*I feel confident that I would make a good research scientist*,” by gender**

20

50

22

6

2

18

37

28

14

3

0

10

20

30

40

50

60

Male (N=687)

Female (N=299)

Strongly agree

Agree

Neither agree nor

disagree

Disagree

Strongly disagree

Percentage

Respondents were also asked what effect their experience as a physics or astronomy student has had on their career intentions (Figure 5). The data suggest that as length of study increases the proportions of both male and female doctoral students with ‘doubts about’ or ‘definitely not wanting’ to pursue a career in science (in areas related to either physics or astronomy) increases. Overall female doctoral students report being more likely than male doctoral students to have doubts about or definitely don’t want to pursue a career in science - 45% and 34%, respectively. Students of both genders report similar intentions in their first year. However, while the proportion of male doctoral students more intent on a career in science falls a little, from 53% in the first year to 45% in the fourth year, the proportion of female doctoral students falls from 53% in the first year to 30% in the fourth year. By their third and fourth years of study 57% of female doctoral students have doubts or do not want to pursue a career in science compared to 38% of male doctoral students in the third and 47% in the fourth year[[9]](#footnote-9).

**Figure 5: The effect of respondents’ experiences as physics/astronomy doctoral students on career intentions by year of study and gender **

These findings present somewhat of a contradiction. While similar proportions of both male and female doctoral students believe they possess the right transferable, general and technical skills for employers, significantly fewer female doctoral students see themselves as being well suited for academia, and are also more likely to be put off from a career in science. That studying towards a doctorate has a negative effect on both male and female doctoral students’ satisfaction with science and academia is not in itself surprising; students face new challenges and have more time to question their skills and their work across the four years of a doctorate. But the differences between male and female doctoral students are particularly pronounced.

Respondents were also asked about which types of roles they expected they would be in both 3 – 5 years and 6 – 10 years from graduation. In 3 - 5 years, relatively similar proportions of male and female doctoral students overall across all four years of study see themselves in a research career. However, this masks a drastic narrowing in the expected range of careers of female doctoral across the years of their doctorate (see Table 2). Male doctoral students’ confidence in a research career remains resilient. Considering those individuals who envisage that they might have a role in a university either as an academic and/or a postdoctoral researcher, in the first year 78% of male doctoral students feel this is likely compared to 65% in the fourth year of study. In contrast, 82% of female doctoral students in their first year feel that they are likely to have a university role in 3-5 years’ time, falling to 48% in the fourth year.

**Table 2: Percentage of respondents specifying selected roles they believe they are most likely to be doing in 3-5 years’ time, by gender and year of study**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Role\*** | **Male** | | | | **Female** | | | |
| **1st Year** | **2nd Year** | **3rd year** | **4th Year** | **1st Year** | **2nd Year** | **3rd year** | **4th Year** |
| Postdoc/Research assistant | 76% | 66% | 69% | 61% | 76% | 64% | 59% | 45% |
| Scientist: industry/commerce (including start-ups) | 31% | 32% | 30% | 27% | 24% | 24% | 38% | 13% |
| Academic | 18% | 12% | 13% | 21% | 16% | 11% | 9% | 13% |
| Scientist: public sector | 5% | 12% | 9% | 8% | 12% | 13% | 11% | 14% |
| Teacher | 6% | 6% | 3% | 11% | 5% | 11% | 11% | 17% |
| **Total respondents** | **225** | **170** | **161** | **110** | **76** | **75** | **76** | **64** |

Respondents were allowed to specify one or two roles. 273 specified a single role and 723 specified two roles (abridged table)

These findings are reinforced in response to the question of expected roles in 6 - 10 years’ time. By their third and fourth years of study around 1 in 5 male students envisage being a postdoctoral researcher in 6 - 10 years’ time compared to around 1 in 10 female students. In 6 - 10 years, 46% of male students expect to be working in academia compared to 37% of female students. The proportion of male students who feel they are likely to be academics ranges from 48% to 45% between their first and fourth year but from 47% to 33% for female students[[10]](#footnote-10).

* + 1. **Discussion: A vicious circle?**

Exploring and addressing the reasons behind the divergence in career expectations between male and female doctoral students is vital. Female students clearly see themselves as having the right skills to enter academia, research and careers in science, yet higher proportions question their ability and are put off from such careers, whilst they are also less likely to see themselves in a research position. This results in women feeling that their career options are being limited and a substantial number of talented people are being withheld from certain sectors.

Certainly, female doctoral students’ less satisfactory experience could contribute to this narrowing of career expectations in any of three ways, one of them unconscious and two of them conscious. Firstly, their experience, combined with a status quo in which women are vastly underrepresented, may serve to reduce their perceived expectation of an academic or research career. Secondly, this perception, whilst accurate, may itself become a self-fulfilling prophecy by actively affecting the career decisions that they make. Thirdly, their doctoral experience may simply put them off, making them less likely to desire a career in research and academia.

Unconscious bias may also be contributing to the lower level of representation of women within academic professions in the first place and may also be reinforcing the expectations and career paths, perhaps in students and within careers advice, of successive generations. As they choose to go into the roles in which they see others, they may then gravitate more towards positions outside of academia. The end result is less representation of women in academia and in research roles, which, completing a vicious circle, then reinforces itself by lowering female students’ expectations of such a career and the perception of a lack of role models on the part of some.

Additional questions show that similar proportions of both genders believe they have a good knowledge of careers within academia. However, female students judge the quality of careers advice they received from both their university careers service and their supervisor as lower than their male peers. That they assess their skills as on par with their male colleagues but are less likely to see themselves in a research career, in academia, or in science cannot just be as a result of their lower levels of satisfaction with their doctorate. Lower levels of confidence in being good potential research scientists suggests that there is an issue with confidence relating to careers, and that the career needs of female students are not being met by the existing careers provision.

Many careers in which female students see themselves as more likely to be working, such as teaching, also suffer from a shortage of women, and serious efforts are being made to increase diversity in these professions. However, it is clear that the career decisions of male and female doctoral students are neither being made on a level playing field nor from shared experiences.

1. We use the term ‘doctoral students’ to refer to all students conducting doctoral study, including those registered on DPhil courses. [↑](#footnote-ref-1)
2. HESA statistics [↑](#footnote-ref-2)
3. http://www.rcuk.ac.uk/RCUK-prod/assets/documents/skills/timodc\_sb\_psaedg.pdf [↑](#footnote-ref-3)
4. Link to full report. [↑](#footnote-ref-4)
5. http://www.iop.org/publications/iop/2012/file\_54949.pdf [↑](#footnote-ref-5)
6. http://www.iop.org/publications/iop/2012/file\_53617.pdf [↑](#footnote-ref-6)
7. 68% of male doctoral students for example believe they would most likely be in a postdoc/research assistant position in 3 – 5 years. A Vitae study (What Do Researchers Do? – 2013) finds that only around 20% of doctoral students from the physical sciences and engineering are in positions as researchers in higher education after 3 and a half years. [↑](#footnote-ref-7)
8. Link to juno explanation. [↑](#footnote-ref-8)
9. Similarly, respondents who had not already accepted a job or training offer were asked whether they intended to seek employment as a research scientist, or undertake further study related to research. While the proportion of male doctoral students indicating a positive response increases slightly from 59% in the first year to 64% in the fourth year, the proportion of female doctoral students falls from 58% on the first year to 43% in the fourth year. [↑](#footnote-ref-9)
10. It is also worth noting the proportions of male and female doctoral students indicating choices outside the top four (academic, industrial scientist, postdoctoral researcher and public sector scientist - all clearly roles as scientists). While little difference is observed in the short-term, in the longer term, 47% of male students in their third and fourth years select roles outside the top four compared with 65% of female students. [↑](#footnote-ref-10)