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Applying Behaviour Change Theory to Understand PhD Supervisors' Barriers and Enablers to Supporting PhD Students with Academic and Other-Sector Careers

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Abstract

Most PhD graduates work in sectors beyond academia. However, only 15% of PhD students report discussing other-sector careers with supervisors. The extent to which supervisors feel capable, motivated and have the opportunity to provide support for academic versus other-sector careers is unknown. This project applied behaviour change theory (COM-B; Michie, van Stralen & West, 2011) to assess and compare PhD supervisors' capability, opportunity and motivation to provide careers support to PhD students for academic versus other-sector careers. An online survey of 39 science-based PhD supervisors at a UK-based University assessed capability, opportunity and motivation to discuss and signpost students to University careers services for academic and other-sector careers (pre-registered: LINK-ANONYMISED). Open-ended questions assessed barriers/enablers to providing support for other-sector careers. However, most reported no training on careers, were unaware of specific University careers resources, and less than one third thought there were sufficient reminders to discuss careers. Supervisors reported significantly greater confidence (p<.001), ease (p=.002) and enthusiasm (p=.03) to discuss academic careers compared to other-sector careers. Open-ended responses indicated that generally supervisors were motivated to support the career development of students for academic and other-sector careers, and that a quick supervisor guide would be useful. It is recommended that strategies which target supervisors' capability (training, guide) and opportunity (e.g. reminders) to provide careers support to PhD students are adopted, to ensure students are sufficiently supported for careers within and beyond academia.

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1. Introduction

In recent years, the career destinations of PhD students have deviated from the traditional model. Rather than a PhD programme leading on to an academic post, most science-based PhD students (around 70%) have left academia for careers in other-sectors 3.5 years after graduating (Higher Education Statistics Higher Education Statistics Agency, 2018; Teelken & Van der Weijden, 2018). Such rates are likely to be maintained, or increase as since the COVID-19 pandemic, increased numbers of PhD holders have left academia for other-sector careers (Gewin, 2022). Pay, working conditions, career fit, pensions, and precarious fixed term academic posts are some of the main reasons driving PhD holders to seek other-sector employment (Gewin, 2022; Hancock, 2023; Sauermann & Roach, 2012). For students with academic career aspirations, they face a limited number of opportunities as academic posts have not increased in line with the rise in the number of PhD awarded over the last few decades (Pedersen, 2014; Schillebeeckx, Maricque & Lewis, 2013). Some reports suggest that the limited University employment goes to those with relevant networks and connections and 'luck' in terms of timing around the availability of funded opportunities (Rasmussen & Andreasen, 2023). Therefore, PhD graduates need to be sufficiently trained for a range of potential career destinations. As such, most doctoral training now aims to embed employability or transferable skills that are relevant to academic and other-sector careers (e.g. communication, project management, problem solving and teamwork) (Denicolo, Duke & Reeves, 2016; Durette, Fournier & Lafon, 2016; Rakowska & de Juana-Espinosa, 2021; Roberts, 2002). The UK's Research and Innovation (UKRI) 2022-2027 strategy has also highlighted the need to ensure researchers are made aware of the wide range of other-sector careers (UKRI, 2022). Specifically, the strategy outlines how the current 'traditional' approach to research careers needs expanding to develop, support, attract and retain highly talented and diverse researchers for innovative research development. The strategy recognises the importance of research development for 'economic, social, environmental and cultural benefits'. Similarly, the Concordat to Support the Career Development of Researchers also recognises that most researchers will work in a range of sectors outside of Universities, and therefore it is critical that researchers are provided with sufficient career development support for the wide range of potential careers available to them (Concordat, 2019).

However, despite this shift towards other-sector careers, previous reports show transitioning to other-sector careers is challenging and students feel underprepared (Cornell, 2020a; Haynes, Metcalfe & Yilmaz, 2016; Skakni, Inouye, McAlpine, 2022). PhD students have limited awareness about other-sector careers and job searching strategies and find the transition to other-sector careers stressful (Hayter & Parker, 2019). Similarly, PhD graduates entering other-sector careers experience culture shock due to differences to academia in group dynamics, work patterns, autonomy and the nature of the work (Skakni et al., 2022). Such challenges may in part, be due to PhD supervisors providing insufficient

support for other-sector career development. According to a Higher Education Policy report (Cornell, 2020b), only 45% of students reported discussing career aspirations with supervisors, and only 15% discussed other-sector careers beyond academia. Similarly, another report suggested that supervisors of post-doctoral researchers provide limited careers support due to a University culture which focuses on a '*figure it out (yourself) and roll with it* approach (Hayter & Parker, 2019, p.364). Supervisors may also have limited awareness about other-sector careers and therefore limit career discussions or appropriate preparations for other-sector cultures (Galimberti, 2023; Hayter & Parker, 2019). There can also be 'glorification' of the academic path (Hancock, 2021, p. 525), whereby supervisors may favour academic career destinations, and deter researchers from other-sector careers (Duke & Denicolo, 2017; Hayter & Parker, 2019). A common theme reported by PhD students is being perceived as a failure and '*feeling that those still in academia would look down on me*' if other-sector career routes were taken (Haynes et al., 2016, p. 50). Furthermore, it has been recognised that institutional support and career discussions with supervisors often occur too late (Fuhrmann Halme, O'Sullivan & Lindstaedt, 2011).

To address such issues, the Higher Education Policy Institute (HEPI) (Cornell, 2020a) has provided recommendations for Universities to improve the provision of careers development for PhD students. Notably such recommendations follow a similar code of principles set out by the Royal Society in 2014 (The Royal Society, 2014). HEPI's recommendations include that Universities provide PhD researchers with access to specialist research careers consultants or improve access if such services exist. Careers services support students to make informed career decisions. It is recognised that it is beneficial to students to consider careers during the early stages of doctoral training (Duke & Denicolo, 2017). Additionally, the HEPI recommend that Universities provide specific careers training to supervisors so they are able to advise and signpost students to available career services (Cornell, 2020a). As such, PhD supervisors play an important role in ensuring that students receive sufficient support for academic and other-sector careers.

Universities in the UK tend to have careers and employability services in place to support PhD students. In 2020, the Association of Graduate Careers Advisory Services, the expert membership organisation for higher education student career development, found that 83% of responding institutions provide careers support for researchers, and 34% of these have careers and employability specialists to solely support researchers. However, in line with HEPI's recommendations (Cornell, 2020a), it is unclear whether PhD supervisors are trained and feel prepared, able and motivated to provide careers support to students for academic and other-sector careers. As per previous findings, glorification of the academic path (Hancock, 2021) may also hinder supervisors' abilities to sufficiently support students exploring other-sector careers. While previous reports have raised concerns about insufficient support for other-sector careers (Cornell, 2020a; Hancock, 2021; UKRI, 2022; Unnamed, 2023), to date (to our knowledge) no research has explored PhD supervisors' perspectives in relation to careers support, nor directly compared supervisors' attitudes, beliefs and motivations (drivers of behaviour) to providing support for academic and other-sector careers. Indeed, a recent special issue of *Studies in Higher Education* on post-PhD careers mostly included articles focusing on PhD students' perspectives around careers (Teelken et al., 2023), but to our knowledge, there is no research exploring PhD supervisors' perspectives on their role towards supporting the career development of their students for academic and other-sector careers. Yet, supervisors play an important role in students' well-being and outcomes. A positive and supportive relationship with supervisors can minimise

stress and be beneficial for researchers' well-being and mental health (van der Weijden & Teelken, 2023). Therefore, identifying potential barriers or gaps in PhD supervisors' support is important to inform areas to target to ensure PhD students receive the support needed, and to equip them for onwards careers in academia or other-sectors.

Therefore, the aims of this study were to: (i) assess supervisors' current practice in relation to providing careers support (discussing and signposting students to available careers services); (ii) assess drivers to providing careers support generally; and (iii) compare drivers related to providing careers support for academic versus other-sector careers. To address this aim, the Capability, Opportunity and Motivation Behaviour model (COM-B), a widely used behavioural science framework, was applied (Michie et al., 2011). The COM-B can be used to identify drivers related to supervisors' perceived capability (e.g. knowledge about careers), opportunity (e.g. sufficient time) and motivation (e.g. enthusiasm to discuss careers) to provide PhD students with careers support for academic and other-sector careers.

2. Methods

2.1. Design and participants

An online survey was administered via Qualtrics (Provo, UT). To take part, participants had to indicate supervising at least one PhD student in the Faculty of Science at the University of XXX as first or second supervisor. Recruitment adverts for the study were circulated via email lists, University newsletters and Twitter. The aim to compare drivers of academic and other-sector careers was concealed to prevent awareness of the study purpose affecting participants' responses. As such, the study was advertised as one investigating PhD supervisors' practice, views and experience of PhD supervision in relation to PhD students' career development. Notably, throughout the survey, participants were asked questions about careers generally, academic careers or non-academic careers. The term non-academic was used in the survey as it is a term which the researchers thought would be most intuitive for participants to understand. However, for the purposes of this manuscript, the term 'other-sectors' is used to align with recent calls to use the most appropriate and non-glorified language (Prescott, 2023). Recruitment took place in May 2022 to March 2023. Power calculations in G*Power with an α of 0.05 and power of 0.80 showed that a sample size of 36 participants would be sufficient to detect a significant difference in scores between academic and other sector careers (one-tailed)[1]. Upon completion, participants were offered entry to a prize draw to win a £30 shopping voucher. The survey was approved by The University of XXXX School of Education ethics committee. The study was pre-registered on Open Science Framework (LINK-ANONYMISED).

2.2. Measures

Current practice

Questions assessed whether supervisors discuss career aspirations with students (yes/no), and when and how regularly career discussions take place. Participants were asked whether they had supervised students who were subsequently employed in non-academic settings (yes/no), whether they stayed in contact with such students (yes/no), and whether

they had invited these students to share non-academic experiences with current PhD students (no/ yes, please detail).

Drivers of providing career support (COM-B)

Unless otherwise stated, questions assessing the COM-B factors were collected using 7-point scales ranging from '1=Strongly Disagree' (or very easy) to '7=Strongly Agree' (or very difficult).

Capability

Participants were asked if they had completed any training on providing careers support to PhD students (yes, please detail: /no). Three questions assessed awareness of the University's careers and employability service and resources for other-sector careers. First, participants were asked to indicate the extent to which they agreed with the statement 'I am aware of resources on non-academic careers that the University offers to PhD students'. Second, participants were shown a list of available careers resources and asked to select which resources they were aware of. Third, participants were provided with a scenario whereby a student asked them for advice about non-academic careers. Participants were asked what they would do, or who they would direct students to if they did not know the answer to their questions (this question was designed to test whether supervisors were aware of the careers and employability service). To assess knowledge of career destinations, participants were asked to estimate the percentage of UK-resident PhD graduates in non-academic employment three-and-a-half years after graduating (0-100 rating scale).

To compare psychological capability to discuss academic versus other-sector careers, two questions were used (repeated twice, one question for academic and one question for other-sector careers, total 4 questions), which asked participants to indicate the extent to which they were confident discussing careers (academic/non-academic) and whether discussing careers (academic/non-academic) was easy/difficult (e.g. "I feel confident that I can discuss academic/non-academic careers with my PhD students").

Opportunity

Four questions assessed perceived opportunity to discuss careers [sufficient time, sufficient reminders, other colleagues discuss careers and it is normal and expected of me, e.g. "I have sufficient time to discuss careers with my PhD student"). For perceived opportunity, questions focused on careers generally and did not compare academic versus non-academic careers.

Motivation

Participants were asked to indicate the extent to which they have a plan to discuss careers with students (I have a clear plan for when I will discuss careers with PhD students). To compare motivation to discuss academic and non-academic careers, three questions assessed perceived responsibility, enthusiasm and concern to discuss academic/non-academic careers with PhD students (e.g. "I feel enthusiastic to discuss academic/non-academic careers with my PhD student"; The thought of discussing academic/non-academic careers with my PhD student is concerning to me).

To compare perceptions regarding the value of academic and non-academic career destinations, participants indicated the extent to which they would feel proud and disappointed (two separate questions) if their student pursued an academic or non-academic career.

Open-ended questions

To further identify barriers and enablers to discussing other-sector careers, three open-ended questions were used. First, participants were asked to detail the main reasons that prevent or minimise having discussions about other-sector careers with students. Second, participants were asked to detail factors that would help or support them to have discussions about other-sector careers with their PhD students. Third, participants were asked to detail any comments about the supervisors' role in PhD students' career development, or services and support provided by the University.

Procedure

After providing informed consent, participants were asked to detail the department they were based in and the number of students they currently supervise as primary and secondary supervisor. Participants then answered questions about general practice in relation to having careers discussions with students (e.g. discussing career aspirations, frequency of career discussions and the PhD stage at this career discussions start). Participants then completed questions assessing perceived capability, opportunity and motivation to provide careers support. Some of these questions assessed careers support generally, and others specified for academic or non-academic careers. As such, some questions were repeated and asked in the context of either academic or non-academic careers. The order that participants completed the academic versus non-academic questions were randomly ordered across participants (i.e. some participants answered specific questions about academic careers first, and others answered questions about non-academic careers first). Participants then completed questions about training, careers service resources, estimated percentage of graduates who work in non-academia, previous students now working in non-academia and open-ended questions. Participants were then asked to report how many students they had supervised to completion, how many years they had supervised students, their gender, and whether they had any comments about supervisors' role in PhD students' career development, or services and support provided by the University. Finally, participants were debriefed and provided with an opportunity to enter a prize draw for a £30 shopping voucher.

3. Results

3.1. Participants

In total, 80 participants accessed the survey. Thirty-eight participants withdrew before completing the survey questions and three were excluded due to reporting no current supervision of PhD students (n = 2) or for providing questionable responses (n = 1, same responses on closed and open-ended answers). The final sample comprised thirty-nine participants (see Table 1).

Participants reported currently supervising between 1 and 12 PhD students (*M*: 4.7, *SD*: 2.5). Most supervised at least one student as first (37/39) or second supervisor (31/39). Most participants reported supervising multiple students (see Table 1). Years' supervising ranged from 1 to 35 years (*M*: 14.7, *SD*: 9.7) and the number of students supervised to completion ranged between 0 and 50 (*M*: 11.3, *SD*: 10.5; note, for total years supervising and supervisions to completion, n = 38 as 1 participant did not complete these questions).

Table 1. *Supervisors' practice in relation to career discussions with PhD students.*

Practice	Number (%)
Number of students currently supervise	
First supervisor	
0 students	2 (6%)
1 student	3 (7%)
2 students	15 (38%)
3 students	9 (23%)
4 students	3 (8%)
5 students	2 (6%)
6 students	2 (6%)
7 students	2 (6%)
10 students	1 (3%)
Second supervisor	
0 students	8 (21%)
1 student	10 (26%)
2 students	13 (33%)
3 students	5 (13%)
4 students	2 (6%)
5 students	1 (3%)
Gender	
Male	24 (62%)
Female	12 (31%)
Prefer not to say	1 (3%)
No response	1 (3)
Discipline	
Biosciences	16 (41%)

Psychology	11 (28%)
Mathematics and Statistics	6 (15%)
Physics and Astronomy	3 (8%)
Chemistry	3 (8%)
When first discussions about careers are discussed	
Within 1st month of PhD	14 (36%)
Within first 6 months of PhD	7 (18%)
Within the first 12 months of the PhD	1 (3%)
At some point during the 2nd year	9 (23%)
12 months before submission	2 (6%)
Other:	6 (15%)
Before starting PhD (interview/application)	*5*
Part-time student with career	*1*
Frequency of career discussions	
Never	1 (3%)
Once or twice during the PhD	2 (6%)
Once a year	7 (18%)
Every 6 months	13 (33%)
Every few months	10 (26%)
Other	6 (15%)
Have any PhD students that you have previously supervised left academia for other sector jobs?	
Yes	33 (85%)
No	3 (8%)
No response	3 (8%)
Have you stayed in contact with previous PhD students who now work in other sectors?	
Yes	27 (69%)
No	4 (10%)
Missing	8 (21%)
Have you ever invited previous PhD students who now work in other sectors to share their experiences of other sector jobs with current PhD students?	
Yes	4 (10%)
No	29 (74%)

Missing	6 (15%)

3.2. Current practice

Most supervisors (38/39) reported that they discuss career aspirations with students. Most (69%) reported discussing careers within the first 6 months of the PhD (at application stage, within the first or sixth month), while 28% reported discussing careers at some point during the 2nd year or within 12 months of PhD submission. Most reported having career discussions at least every 6 months. Of the participants who selected 'other' in response to 'How regularly do you discuss career plans with your PhD students?', one participant reported that it depended on the student and the other five reported that the regularity changed during the PhD, with more frequent discussions towards the end of the PhD.

Most supervisors reported supervising students who were subsequently employed in other-sectors, and most maintained contact with these doctorates. However, of these, only four reported inviting students to discuss their other-sector experiences with current PhD students.

Perceived capability, opportunity and motivation to discuss careers.

In terms of capability, most supervisors (36/39; 92%) had not received training on providing careers support to students. Over half (22/39; 56%) disagreed with the statement 'I am aware of resources on non-academic careers that the University offers to PhD students' (agreed n = 15; 38%; neither agree nor disagree n = 2; 5%; *M*: 3.4, *SD*: 1.8). When asked to indicate which resources supervisors were aware of, all supervisors, with the exception of one, were aware of the Training Needs Analysis plan (see Figure 1). Most supervisors were also aware of the Think Ahead blog (28/29, 72%) and just over half of the supervisors were aware of University training for PhD supervisors on having effective careers conversations with postgraduate students (23/39, 59%) and mySkills portfolio (21/39, 54/%). However, there were multiple resources that most supervisors were unaware of, including the Quick Guide for Supervisors on Career Conversations (n = 3), a career management course for PhD students (n = 3) and opportunities for virtual internships (n = 2). When asked who they would refer students to if asked for non-academic career advice, most referred to the University's careers and employability service (n = 32; 82%), a colleague or contact with relevant expertise (not previous PhD students, n = 16; 41%) or a previous PhD student/post docs who had a non-academic career (n = 5; 13%).

When asked to estimate the percentage of PhD students who work in non-academic careers 3.5 years after graduating, the average response was 72.1% [SD: 14.2; range: 40-100%; note the correct answer is 70% (Higher Education Statistics Higher Education Statistics Agency, 2018)]. Only 5 supervisors largely underestimated the percentage of students who leave academia (estimated 52% or lower; note 1 participant did not complete this question).

For opportunity, most supervisors reported having sufficient time to discuss careers and that discussing careers was normal and expected of them (see Table 2). However, 41% indicated that they did not have sufficient reminders to prompt them to discuss careers with PhD students. In terms of motivation, 49% reported not having a clear plan for when they would discuss careers with their students.

Table 2. *Means (SD), and number (percentage) of agree and disagree responses for perceived opportunity to discuss careers with PhD students.*

Item	*M* (*SD*)	Disagree	Agree	Neither agree/ disagree*
I have sufficient time	5.0 (1.4)	7 (18%)	28 (72%)	4 (10%)
I have sufficient reminders	3.8 (1.6)	16 (41%)	11 (28%)	12 (31%)
Most my colleagues discuss careers	4.6 (1.3)	7 (18%)	19 (49%)	13 (33%)
Discussing careers is normal/expected of me	5.8 (1.1)	2 (5%)	34 (87%)	3 (8%)
I have a clear plan for when I will discuss careers	3.8 (1.5)	19 (49%)	12 (31%)	8 (20%)

**Responses are grouped as disagree, agree and neither agree/disagree. However, a 7-point rating scale was used ranging from strongly disagree to strongly agree.*

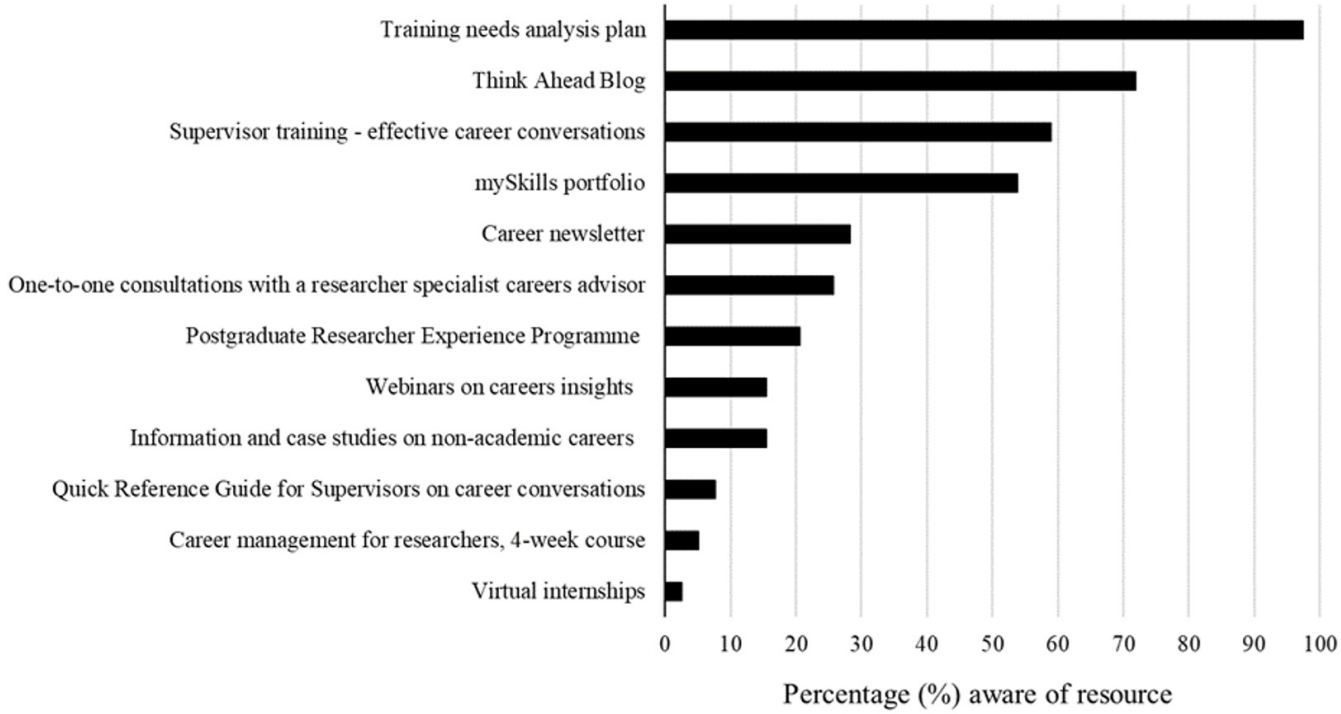

Figure 1. Percentage of supervisors aware of specific careers-related resources available at the University (n = 39).

3.3. Comparing academic and other-sector careers

A multivariate analysis of variance comparing participants' responses to capability (confident, easy/difficult) and motivation factors related to academic and other-sector careers was significant, $F(7, 32) = 4, 81$, $p<.001$, $\eta p^2 = .51$. Bonferroni post hoc tests showed participants reported significantly greater confidence ($p<.001$, $d=.87$), ease ($p = .002$, $d=.54$) and enthusiasm ($p=.03$, $d=.37$) to discuss academic careers compared to other-sector careers (see Figure 2). Supervisors also rated significantly greater scores on feeling proud if their student pursued an academic career compared to any other-sector career ($p=.002$, $d=.53$). Ratings for concern and responsibility to discuss academic careers, and

disappointment ratings for careers destinations did not significantly differ for academic versus other-sector careers.

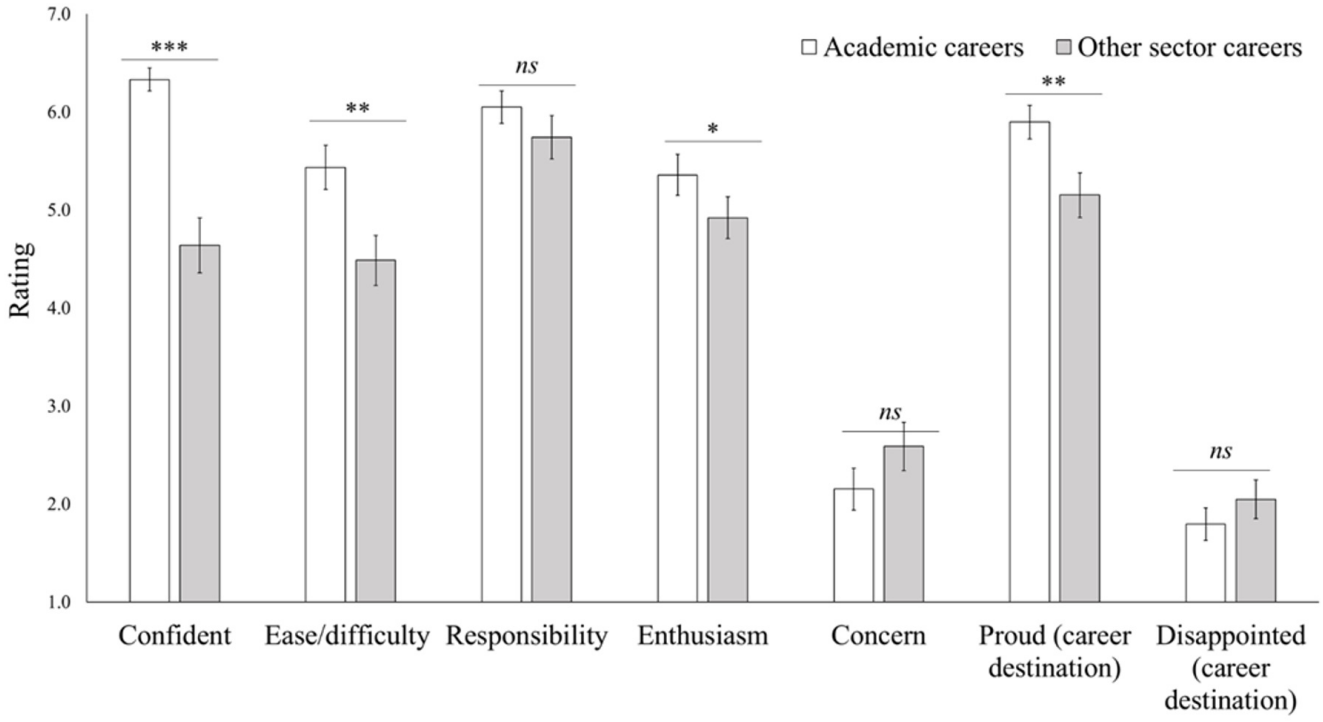

Figure 2. Comparison of perceived capability and motivation factors related to academic and non-academic (other sector) careers (means ± SEM).

3.4. Barriers and enablers to discussing non-academic careers: open-ended responses

Open-ended responses were coded and grouped into themes using an inductive approach in NVivo (released in January 2022) (Braun & Clarke, 2006). Themes and quotes are displayed in Supplementary Materials Table 1. Where relevant, themes are mapped to either perceived capability, opportunity or motivation. Four main barriers were identified: (i) beliefs that there are no barriers; (iii) limited awareness and knowledge; (iii) limited time and resources and; (iv) the academic environment.

Barriers

No barriers

Within this theme, responses referred to no barriers to having other-sector career discussions. This was due to there being no issues generally (e.g. '*Aren't any reasons'* and *'There are no reasons that prevent me discussing this*) or no issues because having careers discussions are important. For instance, supervisors reported '*None, it's important to have these conversations*' and '*There aren't any. My goal as supervisor is to support the student in finding the career that is best for them.*'

There was also one response whereby the supervisor did not think having careers discussions was part of the supervisory role: '*It's not my business. They are grown ups and can / should be making their own decisions in life….. This is not the supervisor's role. We are here to direct the science, not to hand hold intelligent adults.*'

Limited awareness and knowledge (capability)

Referring to limited awareness about other-sector careers or having limited experience in other-sectors was commonly reported as a barrier to discussing other-sector careers. For instance, one participant commented that: '*I have no direct experience of non-academic careers.*' Other examples within this theme include: '*I've had a pretty straightforward and direct path into academia, so I don't have a good sense of what non-academic careers are out there, nor any details about what they involve or how to get into them*', '*It's such a wide and diverse area, and I feel that my knowledge of the topic is lacking*' and '*my own lack of knowledge and experience*'. However, not all supervisors referred to limited awareness of other-sector careers. Some supervisors expressed awareness of other-sector careers, but were not aware of all possible careers paths, for instance '*I have reasonable understanding of many potential non-academic careers, but not all*'.

Additionally, while participants recognised limited knowledge and experience as a barrier, multiple supervisors were keen to offer their support and discuss other-sector careers. For instance, one supervisor commented: '*I am happy to discuss these options with my student, but am aware I lack much real-world experience of non-academic careers - I don't feel well qualified to give advice on routes to take.*' Others reported that '*There's plenty I don't know about non-academic careers but I am always happy to discuss and help a PGR figure out what might suit them best;*' '*I'd happily have the discussion, but my knowledge of many careers is limited and I'd want to avoid giving incorrect advice.*' Another participant reported active attempts to be aware of other-sector careers despite the limited experience of this career destination: '*I'm trying hard to keep up to date with non-academic careers and examples of career paths to be able to discuss these just as much with PhD students as academic careers. The main difference is my lack of first-hand experience of a non-academic career, but I think I can still provide some guidance and pointers*'.

Within this theme, there were also specific references to limited awareness about the career paths and destinations for international students: '*Overseas students--difficult to know systems in other countries*'.

Limited time and resources

Having insufficient time to either consider other-sectors or become more aware of other-sector careers was referred to as a barrier (opportunity) to having other-sector career discussions. For example, one supervisor reported '*I don't know. I feel so busy that I've never got down to this level of thinking. There are so many other things competing for my time.*' Another reported '*I don't have time to inform myself of the processes of applying or being involved in alternative career paths*'. Others referred to '*time*' as a main barrier (opportunity) to having discussions about other-sector careers. There were also comments about the balance of priorities, and that development of other-sector careers may compromise time to complete the PhD (reflective motivation): '*An ex-student decided fairly early on that he wanted to go into industry and I was very supportive of it, and proud and impressed with all the effort he put into training for it and finding such a job, but I feel to*

some degree that I let the majority of his effort go into this direction, to the point that actually finishing his project on time wound up being much more difficult and stressful than it needed to be.' Similarly, another supervisor raised that discussions about pursuing other-sector careers needs to take place between the student and supervisors, to ensure potential competing priorities to the PhD research: '*in some cases, the goals of a PhD will be at odds with many non-academic pathways - it's common to spend more time on professional training activities, teaching, etc when the goal is a non-academic position, and this will necessarily cut into research time). This is something the supervisors AND students need to be aware of, and my sense is that difficulties arise when this inherent conflict isn't explicitly discussed.'*

Other responses referred to limited funds either for training opportunities or for career initiatives such as inviting careers speakers to talk to students (opportunity). For instance: '*There are numerous career advice and development platforms, however there is such little funding for students to take up secondments or travel and explore their career options for themselves.'* In terms of careers speakers, one supervisor raised: *'I haven't invited students who have left academia to come and share experiences with current students because there is no budget for it. The over-reliance on free labour is one of the reasons these colleagues leave academia. Where I cannot change this scenario, I have no intention of asking them to give up time from their work day to fulfil unpaid speaking commitments.*' Another participant commented on insufficient resources from the careers service (opportunity): '*The Careers Service is too general - my students tell me it is of little use to scientific, non-academic PhD jobs other than providing access to psychometric skills practice.*'

The academic environment

The fourth barrier identified was the academic environment students are in. This theme included difficulty around having discussions to inform students they may not be suited for an academic career (motivation). For instance, one supervisor commented: '*A student may have non-realistic aspirations about continuing in academia. This is both a tricky judgement to make and a difficult conversation to have.*' Another shared: '*The biggest issue for a supervisor is that a typical student does a PhD in the hope of pursuing an academic or research career. Many will not "make the grade" for various reasons, but this only becomes more obvious in the later stages of the PhD. It can be very difficult to give this opinion without demotivating them.*' Another commented: '*The biggest issue comes when someone is deluded about their academic prospects but this is rarely an issue for my PhDs - it's more of an issue for undergraduates and again for those who do make it to the postdoc stage but then prove not to be equipped for academia.*'

This theme also included comments that it can be challenging to overcome beliefs that pursuing other-sector careers means the time spent on the PhD was a waste of time (reflective motivation): '*there is a perception that non-academic routes post PhD suggest the PhD was a waste of time - countering this perception can be difficult.*'

Other comments within this theme focused on there being an academic-centric environment whereby students are mostly exposed or have access to academia (physical opportunity). For example: '*When talking to PhD students I am advisor/personal tutor for (i.e. not students I supervise), there are clearly supervisors who put pressure on their students to pursue academic careers as the 'best option'. They also don't feel there is a lot of non-academic careers advice that is on offer from the department - most of the training we provide, and advice we give, is towards securing an academic*

position.' Another commented on the networks PhD students have access to: '*My students work in large international collaborations, and it's easy for them to explore academic career paths.*' Another commented on being more aware about the academic career pathway (capability), but raised concern about the challenging environment of academia: '*I understand academia and can offer much more support for students who choose to go down this path but I'm less and less sure it's a good route to send people down.*'

Enablers

Four themes were identified as enablers for supervisors to have discussions about other-sector careers with PhD students: (i) information and support resources; (ii) more time; (iii) supervisors' motivation to support students; and (iv) the student's role.

Information and support resources

Within this theme, responses highlighted some gaps in supervisors' capability to discuss careers, with supervisors sharing how the survey had made them aware of resources they were not previously aware of. For instance, '*The survey revealed resources I was unaware of*' and '*It's great to know that there are so many more resources I wasn't aware of!*To address capability, multiple supervisors recommended having easy access to information about resources to signpost students to. Supervisor comments included: '*A cheat sheet listing services or support options that they can go to - the information seems to be everywhere*'; '*if there was a clear portal with all relevant info/signposting*' and; '*If I knew better what resources were available locally to direct them to.*' Furthermore, some supervisors highlighted communication routes to maximise reach to supervisors. Comments referred to using department-specific communication approaches. For example: '*I think it would be better for me to be able to signpost them to relevant support (I can't be an expert in all career options)- so a better understanding of what is out there in terms of existing support would be good- as well as better integration of this existing support into individual departments, so that this also doesn't reply on students knowing where to go.*' Another supervisor commented: '*new provision could be usefully signposted from departments. Often university-wide emails might not be perceived (by students or staff) to be as relevant.*' In addition to an easy to access resource, some supervisors referred to having access to destination data: '*Some data on actual percentages of those staying in academia or not, and destinations - this could help frame discussions and dispel perceptions.*'

As well as an easy-to-use resource, some responses referred to increasing supervisors' capability (knowledge/skills) to discuss careers. For instance, '*I think supervisors in general should have more input in student's career development and have more understanding of what the options are, especially outside of academia.*' Another stated '*I would need experience outside of academia*' while another referred to '*More knowledge of options.*' Some responses also referred to training or guidance to increase capability, for instance one response referred to '*formalised training if you are an official supervisor.*' Another referred to training that they had not been able to complete, *I planned to do the "having career conversations training" but couldn't make the date.*' Furthermore, another referred to guides on having careers conversations: '*Official framework for starting conversations in this area.*'

However, another response recognised that despite not personally having much knowledge about careers, the careers service had available resources that had been useful to their students: '*I feel like i'm not best placed to help them with non-academic directions, but the University as a whole had a lot of different opportunities and resources that seemed useful to my students.*'

Responses also referred to the opportunity to engage with previous alumni for current students to discuss careers with. For example, '*It would be helpful if we could better track the PhD alumni from a department. We tend to do this rather informally but I'm not away* (aware) *of a database or a LinkedIn group or whatever that does this - it could be a useful resource to showcase both what alumni do and to provide contacts for PhD graduates and a source of speakers*' and '*Database of non-academic careers experts willing to chat? I feel this is highly field specific - I personally am aware of, or interact with lots of people in different non-academic positions relevant to my field (i.e., relevant to PhD students). But a broader list would help if the student is targeting careers too far away from this.'* Another response *also referred to: 'Facilitating non-academic visitors to give talks to students'* as an enabler. However, as previously noted there were some concerns around the costs and the expectation that alumni contribute for free: '*I have no intention of asking them*(alumni) *to give up time from their workday to fulfil unpaid speaking commitments*' Another issue referred to it not being feasible to contact alumni working in different countries: '*asking students to share their experiences of non-academic jobs is pretty unrealistic. My students have moved all over the world and once they have developed their careers, they rarely have a reason to come back to* [University city redacted]*, especially to talk about their career development*'.

Another enabler identified was providing supervisors with prompts to discuss careers with students at key milestones during the PhD (opportunity). For example, '*the survey revealed resources I was unaware of. Ensuring a review of these is made part of the TNA* (Training Needs Analysis) *would ensure that supervisors know the breadth of what's on offer*' and 'm*aybe add it as a question to the various progression reports. Perhaps a "mandatory" discussion between submission and the viva.*'

More time, resources and training (physical opportunity)

Having more time was referred to by several supervisors to provide more opportunity to discuss careers with students. Responses included: '*More time in the day*' and; '*more time allocated to PhD supervision*'. Having more financial resources for training such as placements, was also identified as an enabler to support career development: '*There is good funding for giving students experience in industry, but only if supervisors have the right contacts so more support in finding placements would be good.*' This participant also compared levels of training on different types of studentships and called for more training models that embed training: '*CDT* (Centres for Doctoral Training) *students get a lot of additional compulsory/cohort training, DTP (*Doctoral Training Programme*) students would benefit from similar programs as otherwise it is difficult to make the time, particularly in later years.*' Another supervisor referred to potential student benefits if more training highlighting transferable skills was implemented: '*I wonder whether we can have happier, less stressed students if we included some (more) non-ac training, or highlighted better how their academic training is useful in non-ac settings.*'

Supervisors' motivation to support students

A motivational enabler identified was the importance of the supervisor for the career transition and supervisors' motivations to support students with career development regardless of career type. One supervisor reported that '*I think supervisors can be critical to support this transition.*' Others highlighted that '*My goal as supervisor is to support the student in finding the career that is best for them.*' Another supervisor commented '*It has always been a great pleasure to support the development of PhD students. For me, the goal has always been to help them to find the career that is right for them, so that they can be as happy and fulfilled as possible, whatever their chosen path.*' Some supervisors also reported active attempts to be able to provide careers support to students, for instance '*I'm trying hard to keep up to date with non-academic careers and examples of career paths to be able to discuss these just as much with PhD students as academic careers.*' While another stated that they provide students with opportunities where possible: *'I try to make sure my PhD students get opportunities to develop beyond academia during their PhDs. For example I strongly encourage and give them opportunities to take part in public engagement activities, communication with the media. I also encourage my PhD students to gain the FHEA or AFHEA* (Fellow and Associate Fellow of the Higher Education Authority)*accreditation while they are here if they have done any teaching.*'

Student's role

The final theme identified recognised the role the student has in career development. For example, one supervisor acknowledged the importance of the supervisors but, also noted that the student needs to be active in this process, and students need to feel supported and empowered to drive the career development: '*careers discussions are important, and the supervisor should help and cultivate these discussions, but the student also needs to take an active role in this process, and I think greater effort should be put into empowering them to explore their career options (e.g., resources, roundtables with past students, etc.).'* Similarly, another supervisor commented that '*It would be good if they felt able to ask to specifically ask to discuss.*'

4. Discussion

Previous reports have identified that University careers support for PhD students is insufficient (e.g., Cornell, 2020a; Hancock, 2021; UKRI, 2022). However, limited research has investigated PhD supervisors' perspectives to providing careers support to PhD students, particularly for other-sector careers. This study applied a behavioural science theory to understand the barriers and enablers to PhD supervisors providing careers support to students. In summary, results showed that most PhD supervisors reported having careers discussions with students, were aware that most students work in careers beyond academia and were aware of general University careers and employability support. However, there were gaps in supervisors' psychological capability (awareness and experience) and opportunity (e.g. prompts, time) to discuss careers. Despite these gaps, the data generally showed high motivation within PhD supervisors to support the career development of PhD students, regardless of whether this was for academic or other-sector careers. These findings will be discussed in line with recommendations for strategies to address these barriers and enablers (see Table 3 for a list

of recommendations).

Table 3. *Summary of recommendations to improve supervisors' capability, opportunity and motivation to support the career development of PhD students.*

COM-B component	Barriers and enablers	Recommendations
Psychological capability	Limited awareness about University career resources. Limited awareness about other sector careers.	1. A quick and easy to use Supervisor Guide which provides links to available careers resources. Importantly, such guides need to be easily accessible. Displaying guides in highly visible and accessible areas such as in offices and around departments can improve access. 2. Supervisors can access this guide and direct students to relevant resources. 3. Careers specific training for supervisors. Such training can be set as mandatory, and be relatively short to encourage engagement with training (e.g. short video covering the most important information). Training can be delivered in forms easy to access, such an online video (can be delivered as part of induction processes and regular training points).
Perceived opportunity	Limited prompts or reminders to discuss careers. Few supervisors reported making plans to discuss careers.	4. Universities regularly prompt supervisors to have career discussions with students. Prompts can be delivered as part of mandatory progress reviews or at key PhD milestones. 5. Training can encourage supervisors to make clear plans about when, where and how frequently they will check in with students on career development.
Perceived motivation	Supervisors reported greater pride for academic career destinations compared to other sector career destinations. Use of language which implies academic careers are superior or the highest aspiration to achieve over other sector careers. Students have a role in their career development.	6. Re-frame supervisors perceived value of other sector careers. This may involve implicit bias training to make supervisors aware about potential implicit positive attitudes they may hold towards academic career destinations. 7. Increase awareness about the language used so supervisors are aware and can minimise language which implies other sector careers are the second choice option for less strong students (e.g. challenging language such as '*many will not "make the grade* (for an academic career).' 8. Support supervisors to empower students to take lead responsibility to explore careers and create a safe environment for students to share their progress and aspirations with supervisors.

COM-B = Capability, Opportunity, Motivation-Behaviour model (Michie et al., 2011).

Limited awareness and experience of other-sector careers was a main barrier identified in supervisors' psychological capability to discuss other-sector careers with students (from both quantitative and qualitative responses). This finding is not surprising and aligns with other research (e.g. Hayter & Parker, 2019) and recommendations that supervisors signpost students to relevant careers resources and are not expected to be experts in other-sector careers themselves (Cornell, 2020a). However, to enable signposting, there need to be clear links to available careers and employability services

(Cornell, 2020a). Within this study, while supervisors were generally aware of careers services, they were unaware of specific resources. Quick and easy-to-use supervisor guides for providing careers support and training on careers are likely to be effective for improving supervisors' awareness of available careers support and resources to signpost students to. The HEPI (Cornell, 2020a) recommend that Universities provide specific careers training to PhD supervisors (Cornell, 2020a). However, such guides and training will only be effective if supervisors are aware of them and can easily access these resources. Notably, the University studied here had an existing supervisor guide that few supervisors were aware of. Similarly, the University had optional training on careers, but within this sample only 8% has completed the training. Therefore, not only are supervisor guides and training recommended, but Universities need to consider and implement the most effective methods to communicate and engage staff with such resources and training. Having supervisor guides distributed at the departmental level, rather than University-wide communications may be helpful. Additionally, ensuring easy access to highly visible or available guides will be important. For example, a poster or two-page page guide can be displayed in staff offices or around departments to improve access and availability of such resources. In terms of training, relatively short training materials can be mandatory tasks for staff to engage with at regular timepoints and/or included in new staff inductions using methods that staff can easily engage with (e.g. training videos). Furthermore, as part of the wider University structures, academic departments and/or faculties need to connect and work together with university careers services. Low visibility is a known barrier to students engaging with University careers services (Donald et al., 2018). Therefore, embedding the careers service within departments and faculties should increase its visibility for both supervisors and students.

Another gap identified in the quantitative data was that a substantial proportion of supervisors did not think there were sufficient prompts to discuss careers, nor plan when careers will be discussed. As identified in the qualitative responses, a main priority for supervisors is to ensure students complete the research required for the PhD. Without planning and sufficient reminders, career discussions can be overlooked. Making a specific plan about when, where and how frequently to enact a behaviour (for example, I plan to discuss careers with my student every two months in supervision meetings), and exposure to prompts or reminders are two behaviour change techniques that can be effective in changing behaviours (Michie et al., 2013; Rogers et al., 2015; Williams & French, 2011). Therefore, it is recommended that Universities prompt staff to discuss careers with students or signpost students to available careers services. Prompts can be delivered at key milestones throughout the PhD, such as during assessments completed at the end of the first year (e.g. transfer or confirmation review examinations) or at mandatory progress reviews. Supervisors can be asked to report whether they have engaged in career discussions with students. Such approaches are likely to be effective as in this study, the resource that most supervisors were aware of (training needs analysis plan), is the one resource that supervisors are required to engage with at key milestones during the PhD. Therefore, implementing prompts to discuss careers at mandatory milestones may help increase career discussions between supervisors and PhD students.

Additionally, developing a database of alumni or using existing databases of alumni was suggested by some supervisors as a potential resource for students (e.g. Campaigns and Alumni Relations teams). Building connections with alumni helps shape students' expectations of other-sector careers and reduces culture shock when transitioning beyond academic careers (Skakni et al., 2022). Alumni can also be invited to provide talks to existing students. Previous work has found

undergraduate students find alumni talks useful (Donald et al., 2018). In the current study there were some concerns about alumni not being sufficiently remunerated and where possible, involvement of alumni needs appropriate funding. However, there may also be cost-effective methods to engage students with alumni. Sharing blogs, podcasts and other online resources documenting career transitions can be a relatively low-cost approach. Critically, such strategies will only work if supervisors are aware that such resources exist and know how to direct students to these materials.

Previous research has referred to the glorification of the academic path, with supervisors favouring the academic career path they have taken (Hancock, 2021), however, such glorification was not strongly evident in the current study. There was greater reported pride for academic destinations compared to other-sector career destinations. Similarly, some of the language used in open-ended responses suggested ideas that academia is the first or superior careers destination, and implied only less competent students go on to pursue other-sector careers [e.g. "*Many will not 'make the grade*" (for an academic career)]. It could be beneficial to address such potential biases and inappropriate use of language which supervisors themselves may be unaware of. Nevertheless, most supervisors expressed motivation to support students to develop a career most suited to them, regardless of whether this is for academic or other-sector careers. Beliefs that career discussions are not relevant to supervisors was expressed by only one participant. Most other participants recognised the importance of career discussion and expressed motivation to support students with this. While it is possible that the sample who took part in this study reflected the most engaged supervisors, the widespread positive comments to support students is still promising and sets up the context needed to test initiatives targeting gaps in psychological capability (awareness) and opportunity (prompts).

A further theme important to acknowledge is the role of the student in career development. Some supervisors stated that while they have a role in career development, the students themselves need to be active in this process. This aligns with Duke and Denicolo (2017) who highlight that alongside supervisors and wider University support, students need to drive forward career discussions and take the responsibility to initiate discussions and seek available support. In communications with supervisors about supporting students, it will be beneficial to highlight the role the student has, and the need to empower students to take the lead role in their career development.

There are several strengths of this work. First, the COM-B model, a behaviour change theory widely used in health and environmental domains, was applied to inform the survey design and arising recommendations (Michie et al., 2011). Use of this model helps to identify the key drivers to target to improve supervisors' provision of careers support to students. In this instance, capability and opportunity were identified as key drivers to target. Despite its wide use in the behaviour change field, applications of the COM-B to inform teaching are sparse. There has been speculation about applying the COM-B to schools (Sharples, 2017), however as far as the authors are aware this is the first application of the COM-B to Higher Education. Given the value of the model, it is hoped further pedagogical research will apply this model to inform study questions and resulting recommended actions (or interventions). Additionally, while research has explored students' attitudes to University careers support (Cornell, 2020a, 2020b), limited research has investigated the supervisors' perspectives. Improving career provision will require input and uptake by all actors, including students, supervisors and the wider University, therefore each needs to be sufficiently explored.

However, there are several limitations that need to be considered. First, the supervisors who took part in this study may reflect a sub-group of supervisors who are most engaged and interested in careers. While a potential risk of bias, the survey collected a range of views, including responses from some supervisors who do not believe careers support is part of their supervisory role. Additionally, even if the sample represents the most engaged supervisors, these supervisors still showed gaps in capability and the need for more reminders to discuss careers, indicating that an intervention is needed to support both the engaged and less engaged supervisors.

Another limitation is the survey assessed PhD supervision generally, and did not assess potential variability in supervision depending on the needs of the student. For example, some supervisors referred to the challenges of providing careers support to international students who plan to work in their home country where the careers landscape is different to the UK. Other research has found that Chinese PhD students studying abroad tend to explore careers themselves rather than seek support from University careers services (Lee et al., 2018). As such, it will be beneficial for further research to gain more detailed and nuanced information about supervisors' experiences and capability, opportunity and motivation to support a range of PhD students. It also highlights the need to ensure careers support is tailored where possible to address the varying needs of students. Similarly, there are reports that the experience of PhD supervision for students from marginalised groups can involve challenges, such as racism that other students are less likely to experience (Ritter, 2023). To gain more in-depth insight into the challenges and variability around careers support for PhD students it is recommended that further qualitative research in both supervisors and students is conducted. Furthermore, these results were collected from one University, and while the data reflects supervisors from a range of science disciplines and experience, it will be beneficial to extend this work to other Universities and disciplines.

In summary, through applying a behaviour change theory, this study identified barriers related to capability (awareness of other-sector careers) and opportunity (prompts) that can be targeted to improve PhD supervisors' provision of careers support to PhD students. It is recommended that Universities provide careers training to supervisors, provide quick and easy to use supervisor guides on career development, provide regular reminders to prompt supervisors to engage in career development with students, and improve connections between University careers services and academic departments.

Statements and Declarations

Authors contributions: NJB conceived the study idea, designed and conducted the research and drafted the first version of the manuscript; KR provided input on project scope and design, and as PGCert supervisor provided support; RE discussed the findings with NJB and provided input on the resulting recommendations. All authors approved the final manuscript.

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Data availability: study data can be found at https://osf.io/hgwdq/.

Footnotes

[1] Note, power calculations were based on conducting a dependent t-test. However, as a deviation from the pre-registered protocol, to account for multiple comparisons a multivariate analysis of variance was conducted.

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