Interdisciplinary Perspectives on Equality and Diversity

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Journeys to Systemic Change: The process of designing evidence-based interventions to improve career progression for marginalised academics

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Abstract

This paper describes how the Evidence Base project used a two-stage approach as a foundation for designing systemic policy and practice interventions, with the goal of improving career progression for marginalised scientists at the University of Edinburgh. Stage one involved carrying out qualitative research with new principal investigators in the physical sciences at Scottish universities who had participated in fellowship and career development programmes. Using in-depth interviews to understand the challenges that participants had encountered in regard to their career progression, we share our research results through two 'personas' and 'journey maps', storytelling and product design tools from consumer research that have rarely been applied to the academic sphere. We used the 'pinch points' that were identified through the journey maps as the foundation for creating evidence-based interventions. In stage two of the project, we engaged with a number of stakeholders across the University of Edinburgh to talk about the research results, discuss these possible interventions, and explore the opportunities and challenges to implementing them. We explore why it has been essential for this work to involve engagement with other stakeholders within the University system, particularly within the context of the major disruption and wide-reaching impacts caused by the COVID-19 pandemic. In conclusion, we offer a number of recommendations based on our experience, with the hope that others can use these to better facilitate the process of designing interventions to create systemic change to improve equality, diversity, and inclusion in higher education organisations.

Keywords: organisational system change, research culture, career progression, interventions, personas, journey maps, diversity and inclusion, STEM

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Introduction

Despite decades of initiatives to improve equality, diversity, and inclusion (EDI) in higher education, there is still a striking lack of diversity amongst staff within the physical sciences (EPSRC, 2021). This is particularly true within the highest levels of academia.

Efforts to improve EDI in higher education organisations to date have generally been focused on 'deficit thinking' approaches, which hold that those who are disadvantaged are responsible for the challenges and inequalities they encounter (Patton Davis and Museus, 2019). These approaches tend to centre on marginalised individuals and primarily consist of events and short-term career development programmes. Deficit approaches are also likely to focus on taking action in regard to specific incidents of subjugation or harassment, rather than addressing the organisational problems and oppressive structures and policies that fundamentally contribute to the development of these circumstances (Patton Davis and Museus, 2019; Golom, 2018; Davidson, 1999).

In higher education, women and racialised minority[1] researchers still face persistent hiring biases (Eaton et al., 2019; Madera et al., 2009; Moss-Racusin, 2012; Sheltzer and Smith, 2014), students continue to be more demanding towards women professors than they are towards men (El-Alayli et al., 2018), and male STEM faculty remain more reluctant than women faculty to take evidence of gender bias seriously (García-González et al., 2019; Handley et al., 2015). Data on the proportion of racialised minority staff in higher education are particularly dire and, as of early 2019, only twenty-five Black women in the UK had been promoted to the role of Professor, out of a total of more than 19 000 Professors in the UK (Rollock, 2019, p. 4). Research with these women indicated that 'a culture of explicit and passive bullying persists across higher education along with racial stereotyping and racial microaggressions' (Rollock, 2019, p. 4). Since March 2020, there have been further wide-reaching impacts due to the COVID-19 pandemic and these have only reproduced and deepened the systemic disparities that directly affect marginalised researchers (Cebula et al., 2020).

Societal inequalities in industrialised countries are reproduced and perpetuated through daily activities within organisations (Acker, 2006). And, as is shown through the literature above, ways of working in academia continue to be designed around the experiences of affluent, able-bodied, cis-gendered, straight white men who have no caring responsibilities (Gonzales & LaPointe Terosky, 2020). As such, exploring how the professional and personal lives of different stakeholders within higher education are impacted by their employer's policies and practices is crucial to understanding how to create effective change within the organisational system.

[1] Choosing to use the term 'racialised minorities', rather than 'ethnic minorities', 'draws attention to the racialisation of people of colour and serves to highlight the discursive power pf whiteness' (Gabriel, 2021).

In 2018, 'Evidence Base: Growing the big grant club' (EP/S012087/1) was one of eleven projects funded by the UK's Engineering and Physical Sciences Research Council (EPSRC) under the 'Inclusion Matters' funding scheme. This scheme is part of a broader movement from UK research funders and learned societies to use their influence to improve 'research culture'[2], which The Royal Society (2018) defines as encompassing 'the behaviours, values, expectations, attitudes and norms of our research communities. It influences researchers' career paths and determines the way that research is conducted and communicated'.

The goal of Evidence Base (eBase) has been to use qualitative research with physical scientists as a foundation for designing and implementing systemic research-based interventions to facilitate research culture change. In this context, the interventions – 'actions taken to make things better' (Schensul and LeCompte, 2016, p. 43) – aim to improve career progression and access to research funding for physical scientists from marginalised groups. Using organisational systems theory as a foundation for this work, which is described in the next section of this paper, Evidence Base has sought to take a 'whole organisation' approach to EDI and research culture.

In order to design new policy and practice interventions to improve career progression for marginalised scientists, we needed to understand interventions that were already part of the organisational system. To this end, stage one of this project involved in-depth interviews with 'new investigators'[3] in the physical sciences at Scottish universities. Our research questions asked: How do current interventions in the form of fellowships and career development programmes support career progression for researchers? What are the challenges faced by researchers at this career stage, particularly by those who are marginalised? Are these challenges reinforced by organisational systems? Are there ways in which these programmes advance EDI? What gaps in the ways these programmes were developed, and in how they are managed and administered, can lead us to new policy and process interventions that have the potential to create systemic change? The results of this research are communicated through two 'personas' and 'journey maps', storytelling tools from consumer research that have rarely been applied to academic research.

After briefly discussing some key themes from the research results, the next section ('Implementation') describes stage two of the process we used to design interventions. This involved conversations with other stakeholders within the University of Edinburgh. We also discuss how our process of intervention design was impacted by and adapted due to the COVID-19 pandemic, which began whilst the data from stage one were being analysed and we were beginning to engage with stakeholders. This impacted which interventions could

[2] For some examples of this work, please see Royal Society of Chemistry (2020), UKRI (2021a) and Wellcome (2020).

[3] As outlined by the 'Competency Framework for Research Funding', designed by the University of Edinburgh's Research Office, academic staff in the 'New Investigator' career stage are defined as 'Newly independent Principal Investigators beginning to manage and lead research projects and teams' (Collinge, 2021).

feasibly be implemented. The paper concludes with a series of recommendations, with the intention that others can learn from our experience to facilitate the process of evidence-based intervention design to create systemic change in higher education organisations.

Systemic Organisational Culture Change

Systems thinking emerged in the 1950s as an interdisciplinary and holistic approach to problem-solving. It was seen as a way to move beyond the increasingly reductive, mechanistic approach of the sciences that was being blamed for causing serious global challenges (Strijbos, 2017). A systems approach to organisational change assumes that 'organizations are best understood as complex, living systems composed of interdependent parts, and that fundamentally altered organizational behaviour ultimately requires an altered system' (Golom, 2015, p. 108). As living systems, organisations are both open and flexible (Burke, 2018, p. 19). An entire system will be affected by changes to its interdependent parts and by changes to the external environment in which the organisation is situated (Golom, 2015, p. 111).

Organisations are constantly changing, but systemic change tends to be evolutionary, rather than revolutionary (Burke, 2018, p. 21). Beginning the process of organisational change with the goal of creating 'cultural change' (which includes deeply held beliefs, attitudes, and values) is likely to be divisive and cause emotionally-charged backlash. Instead, it is more effective to focus on creating behaviour change – sometimes through revolutionary means – that will lead to evolutionary cultural change (Burke, 2018, p. 23). Research undertaken within an organisation to understand how to create behaviour change thereby needs to focus on exploring what systemic causes are underlying particular patterns of behaviour. It is through changing the interlocked policies and practices of the system that cause inequalities, what Acker (2006) calls 'inequality regimes', that we can begin to transform deeply embedded, but ultimately inappropriate, behaviours (Golom, 2015, p. 112). This can eventually lead to organisational culture change. Within the context of our project, it is important to note that Russell Group[4] universities (including the University of Edinburgh, where most of our research took place) are often complex and remarkably devolved compared to other higher education organisations. This has the potential to make creating organisational system change a more intricate and lengthy process.

Change requires leadership, which can come from any part of an organisational system. However, if the change is more revolutionary and ultimately transformational in nature, it is crucial to have leadership for the change effort coming from senior leaders with organisational oversight (Burke, 2018, p. 26). Change also needs to be measured and tracked over time to see what is or is not working, to create priorities for subsequent change initiatives, and to know when milestones have been reached so they can be celebrated (Burke,

[4] The Russell Group is a consortium of twenty-four of the oldest and most elite research-intensive universities in the UK, excluding the universities of Oxford and Cambridge.

2018, p. 25). Interventions that do not measure and report any intended or unintended outcomes, whether quantifiable or based on participant experience, cannot be regarded as able to promote effective systemic organisational change (Guyan and Douglas Oloyede, 2019, p. 26).

'EDI' and Organisational Interventions

Recent workplace initiatives in the UK to reduce discrimination have focused on 'EDI': equality, diversity, and inclusion. In addition to these terms being used in interrelated ways, they are useful to think with together:

> *the term 'equality' allows for a comparative reading of relations of power in the workplace, the term 'diversity' draws attention to the multiplicity of strands of difference, and the term 'inclusion' adds a purposive and strategic dimension to the investigation of interventions to relations of power at work. (Özbilgin, 2009, p. 2)*

In their review of EDI in research and innovation in the UK, Guyan and Douglas Oloyede (2019) identify five categories of intervention to improve equality, diversity, and inclusion in higher education. These are: training (such as to promote diversity or raise awareness of unconscious bias); strategies, policies, or processes (for example, around funding, recruitment, or career breaks); career development programmes (mentoring and leadership training and development); recognition schemes (such as charters and awards); as well as employer engagement and outreach (2019, p. 26). The two categories of intervention we explored for the purposes of this project were 'strategies, policies, or processes' and 'career development programmes'.

As interventions, career development programmes can include mentorship, professional development, leadership training, and women-only programmes. These are all commonly used to promote EDI. Although fellowship programmes are classified by Guyan and Douglas Oloyede (2019) as being policy interventions focused on diversifying staff recruitment, some fellowship schemes also offer coordinated mentoring, professional development, and leadership training. The career development aspects of such fellowship programmes, for example the Future Leaders Fellowships programme (UKRI 2021b), are intentionally designed to support the recruitment of more diverse cohorts and to encourage fellows to adopt behaviours that can help to foster a more equitable, diverse, and inclusive research culture as fellows progress in their careers.

Interventions to 'strategies, policies, or processes' are used to create change to a system's underlying organisational structures. Targeted recruitment strategies to improve diversity and family-friendly flexible working policies and practices are common interventions in human resources departments. Some organisations have successfully diversified the recruitment of new staff by checking the language of job advertisements to ensure they are gender-neutral, using images of real staff to accurately represent actual workplace diversity, providing

profiles of current staff with descriptions of their background and experience, and setting recruitment quotas for gender and ethnicity (Guyan and Douglas Oloyede, 2019, p. 29-30). Encouraged by gender equality frameworks such as the Athena Swan Charter[5], many higher education organisations now have flexible working policies that are accessible to all staff. Many of these interventions appear to target new staff, however, rather than to improve career progression for existing staff.

As an example of how to impact EDI through interventions to organisational processes, in 2018 the Hubble Space Telescope allocation committee changed the way they review applications for telescope time. This decision was based on an evaluation of the previous application review process, which indicated that men were more successful than women over cumulative funding cycles (Reid, 2014). In response to the evaluation, the review panel implemented a 'dual-anonymous review' (double-blind review) process, in which neither reviewers nor applicants knew the identity of the other. Although common in academic publishing, this review method had rarely been applied to allocating scientific resources. After implementing dual-anonymous review, applications led by women were more successful than those submitted by men for the first time in 18 years of record keeping (Strolger and Natarajan, 2019). Resulting from this success, NASA (National Aeronautics and Space Administration) followed suit in 2019 and also introduced double-blind review in an effort to reduce systemic bias (Witze, 2019). As telescope time is a crucial resource for these scientists, particularly in fields of study currently dominated by white men, these evidence-based interventions at the Hubble Space Telescope and NASA will directly impact the career progression of marginalised scientists.

Approach

In stage one of the project, the first author carried out qualitative research in the form of in-depth interviews. Research participants were newly independent principal investigators ('new investigators'), who actively were or had been part of fellowship and career development programmes in the physical sciences.

In stage two of the project, we carried out stakeholder engagement and began the intervention design process. Using the 'pinch points' that were highlighted in the journey maps, we identified organisational policies and practices where interventions could create culture change and improve EDI. We then instigated dialogue with other stakeholders at the University of Edinburgh who worked in these policy and practice areas. This allowed us to develop our ideas for interventions, explore their feasibility, and understand what would need to happen for them to be implemented at the University of Edinburgh.

Developing an Evidence Base for Interventions: Stage One

[5] The Athena Swan Charter is a framework that has been widely adopted by higher education organisations in the UK, and now globally, as a tool to advance gender equality.

Research Methods

Drawing from current fellowship and career development programmes in the physical sciences (primarily in chemistry and physics), the first author carried out qualitative research with participants, programme managers (who had or have a management role in relation to a programme), and programme executives (who are or were responsible for the on-going existence and direction of a programme). We approached such programmes as 'pre-existing interventions' to better understand whether new investigators received the support they needed through these schemes, and where gaps in support could inform the design of our own interventions in the form of 'strategies, policies, or processes'.

In total, the first author completed in-depth, semi-structured interviews with 22 individuals who were recruited through snowball sampling. The focus of this paper is primarily on the data from interviews with fourteen programme participants who were identified as being 'new investigators'. During their time as participants, twelve were based at the University of Edinburgh, and two were at other Scottish universities. The first author carried out an inductive thematic analysis of these data by using the data management, organising, and coding features of NVivo 12 Plus (QSR International, 2020).

Coding began by focusing on the details of the programmes themselves from the perspectives of different stakeholders, such as how the programme was developed, advertised, and managed, and what the recruitment process was like. This helped us to understand how organisational policies and processes may have influenced the diversity of programme participants. This was the starting point for imagining new interventions. Other codes focused on participants' narratives about their professional and personal journeys and their experiences within one or more of the programmes, particularly in regard to opportunities and challenges. Inevitably, other codes centred on programme executives', managers', and participants' experiences of, and perspectives on, what the barriers were to improving research culture, EDI, and career progression for scientists. Brought together, these codes coalesced into themes that formed the basis of the personas and journey maps for the project. The process for developing personas and journey maps is described in the next section and used to present the research results.

What are Personas and Journey Maps?

'Personas' are composites of research participants that are based on research data. In consumer research (which focuses on user experiences of a product or service), personas are developed to be an archetype for a particular category of consumer: the persona represents 'a group of target users who share common needs, characteristics, and goals using a fictional character' (Miaskiewicz and Luxmoore, 2017, p. 358). After the persona is developed, a 'journey map' is created as a visual accompaniment that depicts the persona's experiences, thoughts, and feelings, particularly in regard to the key milestones and challenges, or 'pinch-points', within their story. Having an archetype and being able to see their experience of a

product or service helps designers to keep particular types of consumers and their needs in mind as they design. In the same way, the first author chose to create personas to use as an evidence base for designing policy and practice interventions.

Journey maps can help designers and policy makers to tell a visual story about the cumulative impact of 'pinch points' on an individual's career path. This may help them to better visualise how to influence system change, rather than focus on interventions that are informed by deficit thinking. Furthermore, because the small sample size can lead to interviewees being more easily identified, the personas and journey maps allow researchers to communicate participants' stories whilst preserving anonymity. As personalised stories, they also have the potential to facilitate greater understanding and empathy.

Creating Personas & Journey Maps

When creating a persona, the characteristics that the author chooses to focus on will partly depend on the purpose of the research. Our work is about equality, diversity, and inclusion, so in developing the personas the first author used what are described in UK law as 'protected characteristics'[6] as their foundation.

In the sample of programme participants there was a reasonably even division by gender (8 women and 6 men, all cis-gendered) and there was a striking split on caring responsibilities (only two women had children, but all of the men did). This helped the first author to decide to create two personas, one man and one woman: the man has children and the woman does not.

In regard to ethnicity, the sample of participants was very international, but overwhelmingly white; we were only able to interview two racialised minority academics and they are both men. As such, in order to accurately represent the ethnic backgrounds of the majority of the recruited sample, both of the personas are white, but the woman is British and the man is Greek[7]. This roughly reflects the proportion of research participants who were British and who were European.

In regard to other protected characteristics, all programme participants who mentioned having a partner indicated they were in heterosexual partnerships, so this is reflected in the sexual orientation of the personas. No participants openly identified as being disabled. None

[6] 'Protected characteristics' are nine specific aspects of a person's identity, such as sex, race, age, etc. that are protected in the UK through the UK Equality Act (2010). This protection ensures people who embody any of these characteristics cannot be discriminated against (see Equality and Human Rights Commission 2021).

[7] In the UK, 'ethnicity' is the conventional term used instead of 'race' to describe a person's cultural and genetic geographical origins. In demographic surveys, ethnicity categories will typically attempt to capture both skin colour and cultural group (for example, 'Black Caribbean', 'White Irish', etc.). The authors regard these categories as problematic, but they currently constitute standard usage in Britain (see RDU 2021). In the case of the personas, both have light skin and would be considered white, but they are culturally and linguistically different (British and Greek) and may have different residency status. As such, they may have had very different lived experiences within the UK.

mentioned being pregnant. As the programme participants were new investigators and ranged in age from late 20s to mid- 40s, the age range of the personas reflects this.

In each journey map the persona's career pathway is mapped to the first three career stages of the 'Competency Framework for Research Funding', which was developed by the Edinburgh Research Office in consultation with researchers and the UK's research funding councils (Collinge, 2021). These career stages include 'Aspiring Investigator', 'New Investigator' and 'Experienced Investigator', although neither of the personas has advanced to the latter stage in their journey map. The 'new investigator' career stage is envisioned as being 10 to 15 years long as the researcher establishes a track record of successful funding bids and publications. All of these research participants are still considered to be within that stage.

For personas to be effective tools, they need to be grounded in actual data. Miaskiewicz and Luxmoore (2017) note that qualitative methods are recommended because they are the most effective for capturing behaviour and its associated attitudes, which will affect design decision-making (2017, p. 360). Portigal (2008) also stipulates that personas need to reflect 'the messiness of actual human beings' (2008, p. 73) in order to be useful design tools. In this paper the personas are grounded entirely in qualitative research, which has helped the first author to create detailed and realistic journey maps. The stories that have been produced for each persona are composites of interviewees' experiences. The block quotes cited in the personas are actual interview quotes, but are removed from their original context where they could lead to a participant being identified. The brief quotes in the journey maps are inspired by what participants expressed in interviews, but do not represent direct interview quotes.

Some stories from the interviews inevitably stood out in the first author's memory more than others. However, prior to creating the personas she re-read the interview transcripts, as well as the text that had been coded to relevant themes in the data analysis software. This was to ensure that the goals, challenges, and experiences of each persona represented actual themes that programme participants had expressed in the interviews. As the person who recruited participants, interviewed them, and carried out the data analysis, the first author has a uniquely deep understanding of this data. It is this depth that has allowed for the creation of compelling personas that readers and decision-makers who are engaging with our work have the potential to identify with.

Research Results

The stories that are told through the two personas and journey maps created during the project (Figures 1-4 below) allow us to see two individual researchers progress within the fellowship or career development programme they are a part of and through the organisational system of the University of Edinburgh. The personas and journey maps also depict their career progression pathway within the wider system of higher education from one position to the next, involving several higher education organisations.

Edith Malone
Inorganic Chemist
New PI

Age: 37
Gender: Cis woman
Ethnicity: White British
Location: Edinburgh
Personal context:
Man partner, no caring responsibilities

About Dr Malone:

Edith finished her PhD 8 years ago at Imperial College London. She went on to do a 2 year postdoc in France, and then decided to pursue a position in Scotland because her partner was in Glasgow. She was successful in gaining a 2 year postdoc at the University of Edinburgh.

When she arrived at Edinburgh, her Head of School suggested that she apply for the Aurora leadership programme, which she completed. During the second year of her postdoc at Edinburgh, she applied for and successfully received a Chancellor's Fellowship.

During the first 3 years of her Fellowship, Malone published several articles and also secured a grant to hire one postdoc and two PhD students. Her Chancellor's Fellowship review successfully converted into an open-ended contract in year 3 and she is now a Senior Lecturer with a small lab group.

With a full teaching load and committee responsibilities, her time is more fragmented and she is struggling to find space to think about the future of her research and write funding applications.

Goals:

- Become involved in science policy through a Royal Society of Chemistry committee, with the long-term goal of a senior management position in the university
- Mentor and empower other women to succeed in the physical sciences
- Cultivate an open and inclusive research culture within her lab group

Frustrations:

- Despite her accomplishments, is hesitant to plan to apply for promotion in the next 5 years due to lack of encouragement from her line manager.
- Feels unsure of who to approach within her network for additional support & feedback on more complex grant applications.
- Wants to have a family, but can't imagine how to balance maternity leave with the commitments to her lab.

'It kind of consumes your life in a way… what I don't like – even though I am really guilty of it – is that it's expected as a norm you will work on evenings and weekends, and you will do the stuff you didn't have time to do during the week. Even students are like, "Oh, she didn't reply to my email over the weekend".'

Figure 1: Edith Malone Persona

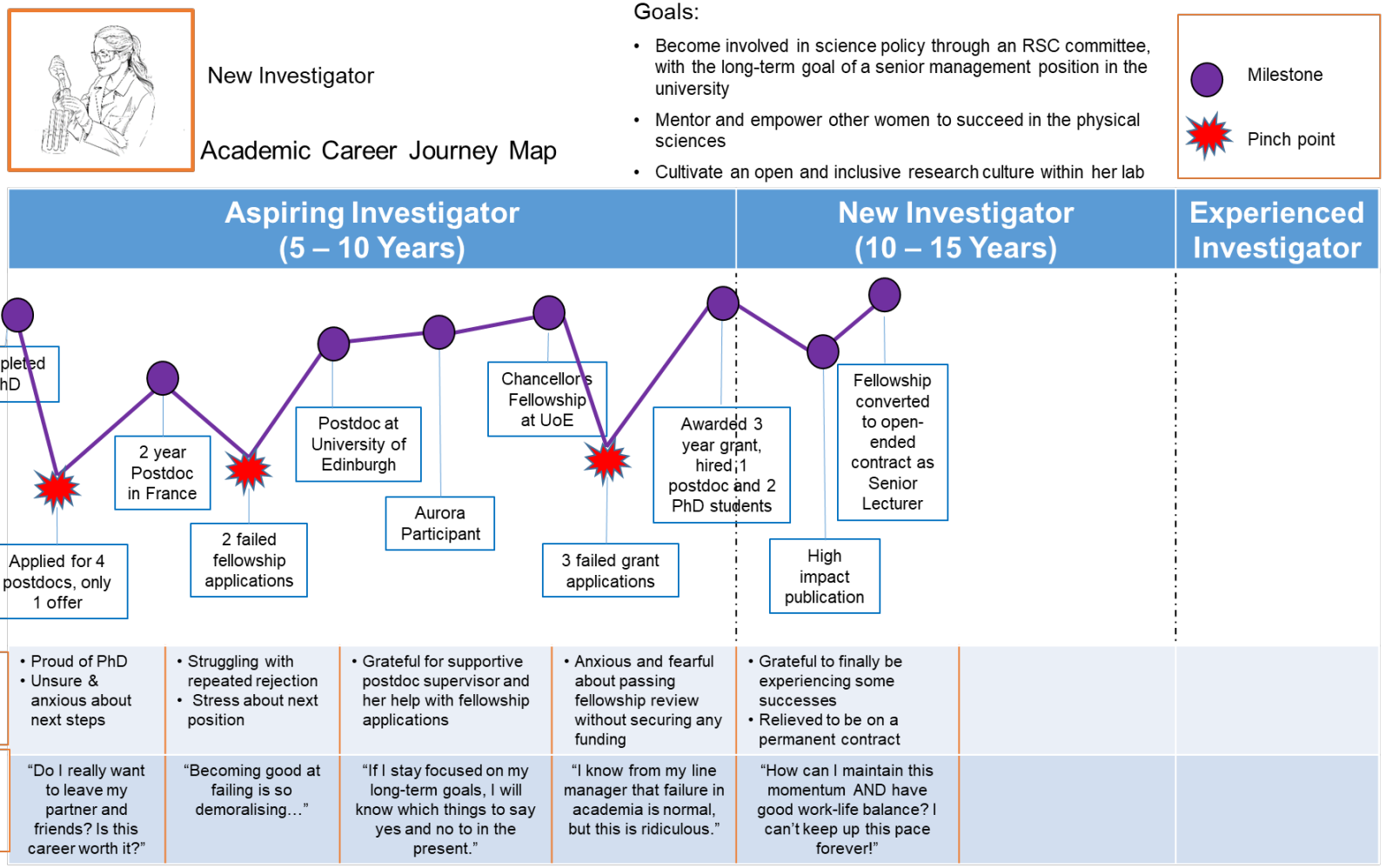

Figure 2: Edith Malone Journey Map

Dimitrius Alexiou
Biophysicist
New PI

Age: 42

Gender: Cis man

Ethnicity: White Greek

Location: Edinburgh

Personal context:

Woman partner,
2 young children

About Dr Alexiou:

Dimitrius completed his undergraduate and master's degrees in Greece before moving to the USA for a PhD at MIT. He relocated to Germany for a first postdoc and then to Edinburgh (with his German partner and their one child) for another postdoc.

During the second year of his postdoc at the University of Edinburgh, Alexiou successfully applied for an EPSRC Innovation Fellowship based on his ongoing collaborations with a European medical device company. He is now finishing the second year of this fellowship.

A permanent position was a condition of the fellowship, but Alexiou's School has not agreed to these terms until they review the outputs from his fellowship. As such, he is publishing and applying for other grants to continue establishing his lab, in order to fulfil his dream of becoming a professor.

However, given this uncertainty, he is considering a career in industry, especially because it may enable a move back to Germany where he and his partner (also a physicist) have more family support and she has more career opportunities.

Goals

- Establish an international reputation in medical device expertise
- Build successful long-term partnerships with industry
- Be a more equal partner at home

Frustrations:

- Needs to minimise overnight travel because of his caring responsibilities, but this can be difficult due to expectations of industry partners and results in lost networking opportunities.
- Concerned about the lack of transparency around promotion within the University and feels the expectations around evidence of 'success' are unclear, especially in regard to work with industry.
- Invited to be a reviewer on EPSRC panels, but doesn't feel qualified to evaluate applications from research leaders.

'Teaching and tutoring and performing research in 35 hours is tough… I mean pretty much impossible. I have definitely felt a loss in competitiveness in terms of scientific output since my second kid was born… The job in itself is not well adapted to being successful and doing what you need and having a proper family life. It's not. At least, for me, it's too much.'

Figure 3: Dimitrius Alexiou Persona

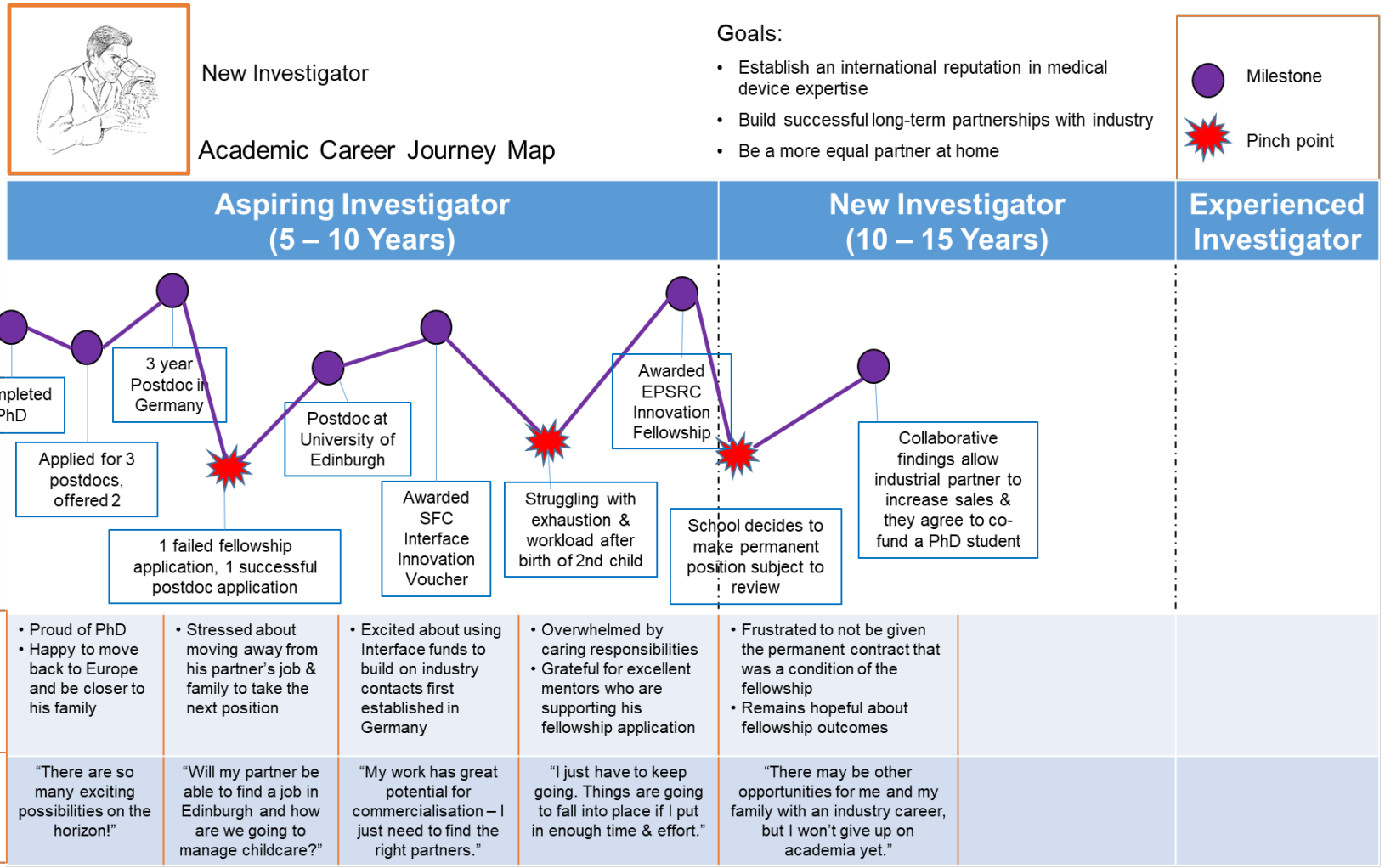

Figure 4: Dimitrius Alexiou Journey Map

The journey maps provide a clear picture of where, within both the system of the University and the broader system of higher education, the new investigators have encountered barriers to their career progression, and what types of obstacles have most affected their journeys. Recruitment and career development programmes are designed to support early career researchers as they move into long-term academic career pathways. Although these researchers are part of an exclusive group who have benefitted from these individually-focused interventions that have significantly advanced their career progression, it is also evident there are systemic forces that have created profound challenges for them. The inequalities perpetuated within these programmes are the same as those in the broader system of higher education within which they are situated.

Discussion

Significant Research Themes

As gender and caring responsibilities were used as the foundational characteristics for the personas, it is perhaps no surprise they were significant themes in the interview data. Whereas the women interviewed were overwhelmingly childless, all of the men interviewed were fathers or about to become fathers. As such, the caring responsibilities theme unexpectedly emerged as a challenge for men scientists. Some of the men who had caring responsibilities tended to feel less successful because they had limited time in which to carry out their work responsibilities; like the persona of Dimitrius Alexiou, they are well aware of all the things they are not able to do, particularly in regard to networking through events and finding the time to apply for funding. Yet, like all carers, these men have remarkably little capacity in their professional or personal lives to alter that situation. Indeed, many of them are proud to be engaged parents and the greater stability and academic freedom provided by a fellowship allowed them to take on more caring responsibilities. Some men spoke openly about embracing this and how it has enabled their women partners to put more energy into their own careers.

Several of the interviewed women spoke about a desire to have a family, as the persona Edith Malone does. However, they did not see a way to realise this aspiration in combination with their workload and the responsibilities to their lab. In contrast, a couple of women mentioned their decision not to have children as a way to demonstrate the seriousness of their commitment to their careers. Importantly, women without children (like Malone) still often feel overwhelmed by their workload. These data indicate that a heavy workload is a widespread issue for all scientists and is directly linked to their capacity to win research funding on their career pathways.

The theme about access to resources is directly linked to workload. All of the new investigators had participated in more than one fellowship or career development programme and this

demonstrates how most of the resources for early career researchers are being concentrated in a relatively small number of people. The difficulty in recruiting a diverse sample of programme participants across all of the protected characteristics supports the likelihood that both fellowships and career development programmes tend to reproduce the structural inequalities that exist within the rest of the higher education system. Career development programmes grounded in deficit thinking are still necessary because marginalised people (including white women) have been socialised to doubt their well-earned knowledge and abilities (Canning et al., 2020; Chakraverty, 2020; Vaughn et al., 2020), and have often not been explicitly trained or mentored in leadership skills (Kamler & Rasheed, 2006; McGuire & Reger, 2003). However, it is clear from our data that these programmes are still fundamentally failing to alter the structures that hold certain groups of people back from finding success as physical scientists within higher education.

Broader Systemic Problems in Accessing Resources

Access to resources relates to another theme in our data about a perceived lack of transparency around the funding and promotions review processes, within both universities and research funding councils. A recent example illustrating these concerns is UKRI's distribution of £4.3 million in research funding to study the link between COVID-19 and ethnicity in 2020. None of this funding was allocated to projects with Black academic leads and one individual who sat on the assessment panel was also a co-investigator for three of the six projects that received awards (Adelaine, 2021). In response to this outcome, researcher Addy Adelaine founded an advocacy group called Ladders4Action, which entered into a dialogue with UKRI about their decision-making processes. In the resulting report, Adelaine (2021) notes that review panels within different funding councils can have entirely different processes for appointing reviewers and evaluating awards. Despite being the umbrella organisation overseeing these councils, UKRI does not necessarily have the power to standardise these processes across councils, which are often the result of longstanding disciplinary traditions.

In parallel, our own interview data indicate that departments within the College of Science and Engineering[8] at the University of Edinburgh have different assessment panel processes from one another, and programme participants did not often know what these processes entailed or who was involved. Whilst this flexibility can be valuable in terms of helping departments to find the

[8] In regard to their organisational structure, Scottish universities use the terms 'school' instead of 'department', and 'college' instead of faculty (a collection of departments with an overarching theme). In this paper we have chosen to use 'department', because it is a more general term across higher education internationally. We have continued to use 'college' because the term 'faculty' can also refer to the academic staff at a university.

staff who best suit their needs, the lack of transparency leaves room for bias to affect which researchers benefit from these programmes.

Contextualising Stage One Methods and Results

Three and a half years after graduation, less than 30% of PhD graduates in the UK are still working in academic roles (Hancock, 2020). This means the new investigators in our research sample are part of a distinctive minority of PhD graduates who have achieved the traditional definition of 'success' in an academic career by finding their way into a tenure-track position within five to ten years of completing their PhD. To have achieved this success, they have a certain amount of privilege, whether in the form of their gender, sexual orientation, socioeconomic background, ethnic background, or in being able-bodied. The first author was able to use snowball sampling to recruit one programme participant who had moved to a position at another university due to their negative experience in a fellowship programme, as well as interview one person who did not initially pass the review that would have converted their fellowship into a tenure-track position (this person passed on a subsequent attempt). They also interviewed participants who experienced microaggressions, bullying, and even a one-off instance of assault during their time in academia. However, it is important to acknowledge that the sample still largely reflects the views of an exclusive group who have managed to succeed in the higher education system.

Failing to recruit many people who are from racialised minority groups, particularly women, may be a reflection of how few racialised minority researchers are able to achieve academic careers within the structures of the current system. In part, this is the legacy of past EDI initiatives within higher education that prioritised gender equality over race equality (Bhopal and Henderson, 2019). It can also partly be attributed to the systemic racism that is all too frequently encountered by racialised minority scientists. Additionally, it may reflect Padilla's (1994, p. 26) concept of 'cultural taxation', which describes how people from racialised minority groups bear the burden of EDI workload in higher education, in addition to their official workload. EDI work is often unacknowledged and unrewarded, which ultimately has long-term negative repercussions for the careers of those dedicated to improving research culture. As a result, some staff members from marginalised groups are understandably selective about choosing to engage with EDI-focused activities, including projects such as ours.

To an extent, it would make sense to design interventions to fix the so-called 'leaky pipeline' in the physical sciences by doing research with those who have already left, whether prior to finishing their PhD, after PhD graduation, or after working as research staff in higher education. And yet, speaking with those who are actively grappling with the current challenges of an academic career has provided unique insight into how traditional definitions of 'success' in

research culture are or are not working for researchers today – even for those who are widely regarded as successful. This work has also provided insight into the experiences and perspectives of those who will be future leaders in higher education and have the potential to change research culture. It is these grey areas and nuances that we have sought to capture and communicate through the personas and journey maps.

Qualitative research is firmly grounded in the time, place, and community in which it was carried out, and any changes to these aspects will affect peoples' experiences and, by extension, how a product, service, or policy should be designed as a result. As culture is constantly changing, Portigal (2008) notes that personas need to be updated after being designed in order to be useful in the long-term. For example, our research data were collected in the months just before the coronavirus pandemic lockdown in the United Kingdom in March 2020, and scientists' ways of working and family lives have changed dramatically in the subsequent two years. Even so, many of the systemic problems indicated in the data, particularly in regard to caring responsibilities and workload, were amplified during the pandemic due to nursery, school, and workplace closures, as well as to the widespread move to home working and online or 'blended' learning in higher education (Cebula et al., 2020).

Implementation: Stage Two

From Research Results to Intervention Ideas

After completing the thematic data analysis, a crucial next step to inform the intervention design phase was to find examples of innovative solutions to improve EDI. We did not set out to create new interventions that might look 'shiny' and innovative, but would eventually fail to generate sustainable impact. Instead, we sought out interventions that had been demonstrated to create culture change elsewhere and would be a suitable fit to address the challenges ('pinch points') identified in the interview data and illustrated in the journey maps. The key was for these examples to be grounded in organisational system change, rather than in deficit thinking approaches. These interventions could then be redesigned to work within the system at the University of Edinburgh.

We carried out a literature review to find examples of systemic EDI interventions, both within higher education and more broadly in other types of organisations, but there is limited academic literature on this topic. Another source of ideas is a database of evidence-based 'good practice initiatives' hosted by Advance HE (2021) that have emerged through the Athena Swan Charter. Once again, many of the listed interventions do not represent systemic approaches to academic culture change, but the database is a useful resource to benchmark what other universities are doing to improve EDI.

The first author attended a lecture by Professor Paul Walton and became particularly interested in two systemic interventions used in the Chemistry department at the University of York that have demonstrated significant impact (Walton, 2016). These eventually became two of the intervention ideas that we recommended at the University of Edinburgh: the 'Unconscious Bias Observers' scheme (Bonello et al., 2017), and the 'Part-Time Working Assurance Scheme'.

The York Chemistry department trained people to notice and respond to unconscious bias in others, whom they called 'Unconscious Bias (UB) observers'. These people went on to act as observers in academic recruitment panels, and the UB observer role became mandatory in the department from 2014 onwards. After this intervention, the proportion of women research staff moved from 30% in 2008 to 40% in 2018. More women were also successfully promoted from Lecturer to Reader (from 25% in 2008 to 33% in 2018) and, notably, most of these women were working part-time when they were promoted (York Chemistry, 2018, p. 35). As far as we are aware, no data have been reported on how unconscious bias observers have impacted the hiring rates or proportion of staff from other marginalised groups, including racialised minority and disabled researchers. However, this intervention has the potential to create systemic change for staff with other protected characteristics.

This leads to the second intervention from the University of York, which is a 'Part-Time Working Assurance Scheme'. This guarantees – to the fullest possible extent, based on finances and role availability – that staff who choose to move from full-time to part-time hours due to family commitments, poor health, etc. will be able to return to full-time hours in the future (York, 2021). In Chemistry at York, this flexible working policy has encouraged a significant number of men to work part-time (from 3% in 2009 to 18% in 2019). This shift has the potential to create cultural change by normalising part-time working for all genders, thereby lessening the systemic stigma and long-term career penalties faced by women who work part-time in academia. Based on York Chemistry's successful promotion of several women from Lecturer to Reader who were working part-time, this policy intervention seems to be having its intended impact on research culture.

Moving from Ideas to Design

At this stage of the project, having identified potential interventions, it became important to address how these might be implemented. One potential way forward was to pilot interventions on a smaller scale before thinking about wider implementation across the College or University. This led the first author to discuss some of the proposed interventions and their feasibility within a university department at the University of Edinburgh. It became clear during these discussions that navigating the implementation of interventions was going to be a substantial activity, quite different in nature to the research conducted to date. This was especially true in the context of the

COVID-19 pandemic with budget restrictions and additional demands on the time of all staff. Although the plan from the beginning of the project had been to pilot interventions within one or two departments, these discussions occurred just three months after everyone had moved to working at home due to the pandemic. As a result, the UB observers intervention was considered too resource-intensive to pilot, primarily due to changes in staff availability and increased workload.

Following these discussions within the department, it became clear that to successfully approach the implementation of interventions, the first author needed a broader and deeper understanding of the organisational system. The journey maps showed us where the 'pinch points' were for researchers, but not how these intersected with the roles, responsibilities, perspectives, and experiences of other stakeholders within the system. These other stakeholders primarily consisted of professional services staff working in areas of the University related to the policies and processes that we sought to change to improve research culture. We also realised that speaking with professional services staff could help us to have a better understanding of how non-academic stakeholders within the organisational system are impacted by research culture. Little has been written on this topic to date, although a survey by ARMA (Association of Research Managers and Administrators) indicated 'a "them and us" culture between academic/researchers and professional services/research support' (Noone, 2020, p. 10).

Stakeholder Engagement

Exploring these questions led to collaboration between the first and second authors to carry out stakeholder engagement. This involved identifying relevant stakeholders within the University system and speaking with them about their role and hearing their perspectives on our intervention ideas.

We engaged with twelve stakeholders across the University of Edinburgh in a variety of roles and departments. The purpose of these conversations was to: 1) understand how different parts of the University system 'work' together, 2) gain insight into how official policies and processes are actually enacted and how these might vary in different parts of the University, and 3) understand how policies and processes could be changed. This engagement provided crucial context that allowed us to better understand the possibilities for creating systemic interventions during a time of immense pressure and change within the organisational system, and within the higher education system more broadly. Engaging with these stakeholders also validated professional services staff as fellow architects of research culture within the higher education system.

For example, in regard to the UB observers scheme, some research participants told us they felt there was a lack of transparency in how departmental sifting[9] panels reviewed applications for fellowships and career development programmes. This helped us to understand that we also needed to engage with the people responsible for managing and carrying out the sift process to understand the process from their perspective. Speaking with staff in more than one department gave us greater clarity on how these processes operated differently between departments, as well as how they worked within a college-level review panel. We gained an understanding of why those differences existed and what would be involved in changing any aspect of how these processes worked. This engagement also gave us an opportunity to present our ideas to the stakeholders who would be tasked with implementing any changes to policies and practice. Their feedback on our ideas allowed us to ensure that our interventions were practical and that they directly addressed the challenges these stakeholders were experiencing in their role. These discussions would also prepare them for any actual changes to policy and practice that may come about through our work and, ideally, encourage them to support those changes.

Recommendations

The timeline, pandemic, and staffing issues the Evidence Base project experienced did not allow us to pilot and evaluate any systemic interventions. However, we learned important lessons through the process of carrying out research to develop an evidence base for EDI interventions, and in engaging with stakeholders to understand the practical elements of implementing them. Based on our experience, these are the recommendations we have developed for colleagues in higher education who are seeking to create systemic change to improve research culture in higher education:

1. Interventions to create systemic change should be grounded in evidence to be effective. Qualitative research is necessary to understand lived experience within a specific organisational system.
2. To design and implement systemic change in higher education, it is essential to understand and respect the knowledge of professional services staff as key stakeholders. Academics cannot change research culture alone.
3. Systemic change requires comprehensive stakeholder engagement across the organisation at all levels, and this cannot start too early. It is necessary to ensure interventions are practical and collaborative.
4. Use appropriate tools (such as personas and journey maps) to communicate the evidence for interventions to each stakeholder group. Ensure these tools are in accessible formats and without jargon.

[9] 'Sifting' refers to the process that review panels go through to shortlist applications.

5. Don't re-invent the wheel: there are great interventions being used to successfully create systemic change in other organisations, including outside of higher education and in other parts of the world. Adapting these (with appropriate acknowledgement) reduces risk to an organisation.
6. Plan and prepare how you are going to measure the impact of an intervention over time before you implement it. There needs to be a way to attribute any positive changes in research culture to the intervention in question.
7. Systemic change to research culture requires long-term organisational investment. Whilst voluntary work by individuals and work associated with short-term funding are valuable, they are insufficient for the stakeholder engagement and implementation/review cycles that are required to create effective and sustained change. Secure the future of interventions by explicitly incorporating responsibility for their implementation, monitoring, and evaluation into new or existing staff roles.

Conclusion

Stage one of the Evidence Base project began by carrying out qualitative research to understand how current interventions, in the form of fellowships and career development programmes, support academic career progression. This research demonstrated that while these fellowship and career development programmes do support the career progression of particular individuals, the systemic issues that discriminate against marginalised academics remain intact. This was especially evident in the difficulty we had recruiting a diverse participant sample from these programmes. In order to equip researchers with the survival skills necessary to succeed within the higher education system as it currently stands, 'deficit thinking' initiatives are still necessary. However, it is clear these programmes will not solve the systemic problems that continue to detrimentally impact the career progression of marginalised researchers in the physical sciences.

Using the research from stage one as a foundation, we developed personas and journey maps as novel and effective analytical and communication tools. They protect the identities of participants, whilst also demonstrating the patterns of progression and pinch points across their careers. In this way, the personas and journey maps enable a broader understanding of how early career researchers experience the higher education system within a complex organisation, and help to facilitate greater understanding within and across stakeholder groups.

As Evidence Base progressed, it became clear that academic researchers cannot solve the problems of other academics within an organisational system without considering the contributions of the wider university community. The stakeholder engagement in stage two taught us that a profoundly practical approach is necessary to successfully create policy and practice interventions, evaluate their impacts, and embed them within an organisation.

The interventions that we began to explore have the potential to challenge embedded cultural norms in higher education organisations. They could do this by reducing opportunities to discriminate against marginalised applicants (such as through 'unconscious bias observers'), or by providing opportunities for staff to prioritise their personal needs for a period of time without losing momentum or progression in their career (as in the 'part-time working assurance scheme'). Creating organisational system change is difficult, particularly at a time when the higher education sector is still reeling from the COVID-19 pandemic. However, this is exactly when marginalised researchers in higher education have the greatest potential to be left behind, and thus when the need for systemic innovation in regard to EDI is the most urgent.

Credit Statement

Author 1: Conceptualisation, Methodology, Formal analysis, Investigation, Data curation, Writing – Original draft, Writing – Review & Editing, Visualisation, Project administration.

Author 2: Methodology, Investigation, Writing – Review & Editing.

Author 3: Writing – Review & Editing, Project administration.

Author 4: Writing – Review & Editing, Supervision, Project administration.

Author 5: Conceptualisation, Methodology, Writing – Review & Editing, Supervision, Project administration, Funding acquisition.

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