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A new lens on a persistent problem: using emergent theory to investigate the barriers to progression of female STEM academics at a UK university

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ABSTRACT

Science orientated disciplines have reported gender disparities in terms of barriers into, and progression within. The disparity within is most notable at senior levels. To explore this matter we interviewed 21 female STEM academics at a UK university. The structure of these interviews followed a framework proposed by Bimrose et al. (2014) that contains six distinctive themes impacting on the career trajectories of women generally. To our knowledge, this is the first study of its kind to test the applicability of the framework and offers the potential to provide a more nuanced understanding of the gender disparity in progression for STEM disciplines at other universities with similar employment and cultural profiles.

The thematic structure of the framework proved a useful mechanism to elicit evidence both internal and personal to women, and those that are more directly employer-related whilst recognising the interaction of such factors. Those women who had transitioned to senior management described the planning and development of strategies to manage periods of absence or part-time work as critical to their success. In order to see progression as a real and viable opportunity, women need to be supported and valued in the workplace. We recommend further exploration of the adjustments required in the workplace in order for gender equity in STEM academia to be realised.

KEYWORDS

STEM; SET; STEMM; Science; Gender; Equality; Higher Education

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INTRODUCTION

There has been extensive gender inequality research around career progression and salary disparity, both within the UK (Knights & Richards, 2003) and abroad (Bertrand & Hallock, 1999; Toutkoushian, Bellas, & Moore, 2007). This disparity is more acute in science, technology, engineering and maths (STEM) occupations, relative to non-STEM occupations, again both nationally (Blickenstaff, 2005) and abroad (Shalala et al., 2007). Currently only 13 per cent of all STEM jobs in the UK are occupied by women (House of Commons Science and Technology Committee, 2014). Gender distribution and progression in STEM employment varies widely by discipline (August & Waltman, 2004; Monroe, Ozyurt, Wrigley, & Alexander, 2008). More than 50% of medical students are female yet the percentage of women in senior roles is considerably less with only 24% attaining consultant grade (Miller & Clark, 2008). Currently, only 8.7% of engineers in the UK are female (Kiwana, Kumar, & Randerson, 2011).

Academics have published numerous studies examining STEM disciplines and gender equality in the wider society. Monroe et al. suggest that some of the answers may lie in academia itself and suggest we begin to “look to our own houses” (2008, p. 215) to understand the barriers women face. Evidence suggests that academia is not immune from gender disparity (Equality Challenge Unit, 2014); with only 17 percent of senior STEM academics being female (House of Commons Science and Technology Committee, 2014).

The issue is important to address for equity reasons and also economic ones. An Australian study by White (2014) concludes that the costs of training so many female scientists only to see large numbers leave the discipline is, in the long-term, unsustainable. In the UK it has been recognised that the economy needs more STEM workers, and demand cannot be met without recruiting more women (House of Commons Science and Technology Committee, 2014). Under-representation in senior scientific roles needs to be addressed further to ensure the scientific workforce draws from the widest possible pool of talent and experience, in order to maximise innovation and creativity (Royal Society, 2014). The UK’s recent referendum vote to leave the European Union (EU) has increased pressure to promote careers in the STEM sector (McGiveron, 2016). The Brexit vote has exposed concerns that the foundational strides that the EU have made in terms of women’s participation in science, technology and engineering in the UK (WISE, 2016) are not undermined.

The gender disparity problem has been recognised in other westernised societies with initiatives and investigations of similar scope to that of the House of Commons Science and Technology Committee being undertaken in Europe (genSET, 2011) and in Australia (McKeon Review, 2013). In the US, Schiebinger (2008) highlights

the societal benefits of diverse groups of scientists contributing to studies, leading to better research outcomes for both men and women as a result.

Despite work and commitment from STEM disciplines to address gender inequity through research, policy, innovations and initiatives, the disparity figures remain stubborn. There is growing recognition that what is required is a holistic approach that deals with the complexity of the issue rather than a reductionist view that deals with contributing factors in isolation. Addressing one element of the issue will not lead to sustained change for either the individual or their discipline. Current estimates suggest that, based on the current pace of improvement, it may take between 50 and 80 years to reach gender equality (House of Commons Science and Technology Committee, 2014).

Literature investigating generalised work-related gender disparity cites reasons both numerous and complex. Many highlight the difference between the rhetoric and reality of policies and practices. An example of this is workplace inflexibility (Cabrera, 2009) as even where flexible working is a policy this is rarely an entitlement. It also often requires negotiation with predominantly male line managers who might find the request conflicts with their own experience of having to work long hours in order to meet service delivery targets (Gregory & Milner, 2011). Wider societal values are said to place more value on the 'male' traits of rationality and objectiveness that are associated with managerial or technical positions, rather than the 'soft skills' such as communication and empathy, more associated with women (Ashcraft, 2001).

These issues found generally in workplaces are increasingly reflected in commercialised and marketised academic institutions which also favour more male qualities of managerialism and the use of hierarchical power, over women's more collegiate leadership practices (Fitzgerald & Wilkinson, 2010). The disparity in academia has implications wider than university sector employment: it means young female STEM students do not see the positive female role models which are important for awareness of STEM career pathways as they gain their education. This serves to inculcate the male-dominated culture (Watt, Richardson, & Devos, 2012), and addressing issues in academia is therefore vital to achieving real and sustained change across the STEM disciplines.

Disparity issues may be separated into two categories, whilst recognising the relatedness of the two. The first is recruitment into STEM disciplines and the second is the progression through to senior positions. It is the second factor that is the focus of this research, noting that it is impacted on by the first. Recruitment into STEM disciplines is highly variable. For example, the proportion of first degree students who are female varies from over 79% in disciplines in Psychology and Behaviour Sciences and Veterinary Science to 9.6% in Mechanical, Aero and Production Engineering disciplines (Royal Society, 2014).

As alluded to above, there have been initiatives to improve gender equity in STEM careers in universities. After a thorough review, The House of Commons Science and Technology Committee recommended a further series of initiatives to

encourage an inclusive university culture. These include; unconscious bias training, diversity and equality training, positive action to identify suitably qualified female candidates for senior roles, and mentoring schemes to encourage women to apply for such roles. It also urged HEIs to emphasise both male and female role models who have successfully combined a STEM career with family (House of Commons Science and Technology Committee, 2014).

However, policies at the national level may not be effective in improving diversity without further insight and support. While the UK is said to offer strong policy guidance, the evidence on impact is weak (European Commission, 2008). Sometimes policy failure can be due to under-utilization or because it is undermined by contextual pressures (Schimpf, Santiago, Hoegh, Banerjee, & Pawley, 2013). Some sizeable interventions have been characterised by limited achievement (Best, Sanwald, Ihsen, & Ittel, 2012), suggesting that further understanding is needed of the barriers to the career progression of women. Instead, Herman and Webster (2010) propose more nuanced localised policy changes rather than national structured interventions. Indeed, policy should reflect the fluidity and diversity of the lived experience of women.

Current research on women and careers can be divided according to two separate levels of investigation. The first is on factors external to women. These include workplace culture, values and demands and how these might present as barriers to female recruitment, progression and retention. The second is to examine the individual's perception and management of potential conflicts with reference to work-life balance. Currently the majority of research has investigated external or macro level barriers while the perspective of the individual is less documented (Duberley & Cohen, 2010).

The literature thus offers a strong rationale for research at the local level to identify nuances of how institutional policy and practice is reflected in the lived experience of female staff. In this study we undertook an empirical investigation at a large post-1992 university in the UK. The university, based in the West Midlands, has plans to improve female progression in STEM disciplines and ensure optimum development of its staff. Acknowledging that competitive advantage is achieved predominately through staff, staff engagement and progression is seen as a key driver in transforming the institution. The university has pledged to address gender disparity in the career development of its academic science staff as part of its Athena SWAN Bronze Award action plan. (Athena SWAN is a charter set up by the UK's Equality Challenge Unit to encourage advancing the careers of women in science, technology, engineering, maths and also medicine. It has now expanded to include the arts, humanities, social sciences, business and law as well as other professional roles.)

Thus the aim of our research is to investigate responses of women working at the university to understand the factors affecting progression from an individual perspective. We also asked for their experience of the functioning of existing supportive work/life balance policies. This research allows us to test a new framework claimed to offer an understanding of women's career development to

see if it offers insight for the identification, development and implementation of new practices (Bimrose et al., 2014) both at the host university and at those of other Western countries where gender disparity has been found to persist (e.g. Best et al., 2012). The wider value of this work is that, in testing the framework in this context, it generates insights that can be applied to other studies. The following section identifies and reviews previous research to both frame the investigation and provide a rationale for our selection of the theoretical framework.

LITERATURE REVIEW

The focus of this work is on women who are: working in academia, specifically in STEM disciplines, and investigates reasons for lack of progression into senior roles. As such it operates at the convergence of three classes of likely issues: those focussed on gender disparity in careers of university staff, those found in STEM disciplines, *and* those associated with progression to senior roles.

In recent years the university sector has grown closer to other areas of employment in generally becoming more stressful places to work for all of its employees, with demands increasing and staff satisfaction eroding (Kinman & Jones, 2003). Salient stressors for a study of UK academics included the perception that their job was interfering with their personal life and the level of personal sacrifice necessary for career advancement, with 72 per cent of respondents (male and female) saying their families suffered as a result of the demands of their job (Kinman & Jones, 2003). However, in a further analysis of stress in the UK HEIs, gender was not a moderating effect, indicating no significant difference between men and women in reporting such frustrations (Kinman & Jones, 2008).

However, some of the issues raised above do have particular resonance for female staff. It is argued that failure of management leadership, poor mentoring and education all have greater impact on female employees (Cropsey et al., 2008). Research from America categorised factors which influence disparity into two main types. The first type is characteristics peculiar to the academic, such as the difficulty of staying networked during a career break and maintaining a current publishing record. The second is related to the individual's needs, which incorporates how the woman plans for and navigates career breaks whilst minimising impact on their overall career trajectory (Mavriplis, Heller, & Beil, 2010). Related to this, another factor identified in a university-focussed study is how women relate to their institution, with women more likely to succeed when they recognise that gender-related barriers to progression exist and make a conscious decision to overcome them (O'Meara, 2015).

Science, engineering and technology careers have particular challenges for women; they have a masculine culture with an expectation of long working hours (Herman & Webster, 2010). The traditional science career has at the centre a 'monastic male who has no responsibilities other than doing science' (White, 2014, p. 5), who follows a linear career path with a critical period of activity required between the ages of 25 and 35 during which he is to be mobile and have no other commitments standing in the way of progression to senior roles. The science disciplines are led by men who have followed this path and then proceed to mentor young leaders they

identify as fitting this single-minded model (White, 2014). This may be related to the reason some women find science and technology careers unappealing, as, in part, more selfless features typically associated with feminine goals, such as helping people, are less rewarded (Diekmann & Steinberg, 2013). Grove (2013) suggests traits more frequently associated with men can result in men being more confident in putting themselves forward for promotion. This career confidence is also a factor in how successfully people manage their careers (Fiori, Bollmann, & Rossier, 2015).

Additionally, the critical period for progression noted above has a significant impact for woman who wish to take a career break to look after children. This is reflected in research that found women working in science are less likely to take career breaks than women who work in other occupations. Furthermore, when women working in science do take career breaks to look after children they are often for shorter periods of time than in other disciplines (Royal Society, 2014).

A critical factor in examining different approaches to work between the sexes is the management of work/family conflict (Casper, Harris, Taylor-Bianco, & Wayne, 2011; Hagelskamp, Hughes, Yoshikawa, & Chaudry, 2011). Career interruptions, such as for caring responsibilities, are harmful to maintenance of skills (and in the case of academic scientists, maintenance of an up-to-date publishing record), and returning to work part-time results in prolonged job scarring (Herman & Webster, 2010), with employers perceiving family leave as a signal of lack of career commitment (Theunissen, Verbruggen, Forrier, & Sels, 2009). The impact of childcare responsibilities on the career trajectory of women in both the general employment sector and specific occupational contexts has been found to be considerable (Suitor, Mecom, & Feld, 2001), to affect vocational interests (Lippa, 2005), and individual employment values (Cinamon & Rich, 2002; Hakim, 2006). Indeed work/family conflict is argued to be the biggest single factor in a woman's decision to accept a senior management position and more critical than any factor at the organisational or macro level (Vianen & Fischer, 2002). A large-scale study of work/life balance in Ireland found that these issues persist at all stages of career, not just at childbearing age, with all ages of employees finding conflict between achieving a work/life balance and perceived negative career consequences (Darcy, McCarthy, Hill, & Grady, 2012).

Role identity theory has been used in several relevant studies as a theoretical framework to examine women's conflicting demands of work and family (e.g. Casper et al., 2011; Hagelskamp et al., 2011). Identity theory proposes people have multiple roles, each having expectations and values attached to it (Stryker & Burke, 2000). The identity of a role, such as mother or professional, acts as a guide to how to behave; and the higher the salience of the role, the higher the probability of choosing behaviour which accords with expectations attached to that role. Casper et al. (2011) suggest that when these roles conflict, people are more comfortable for highly salient roles to interfere with less salient roles compared to the reverse, and that people act in line with their concept of their role. As an example, in a culture where the family is highly valued, and work is perceived as interfering in that role, a negative effect would be generated towards the source of

the interference. This could result in reduced loyalty or commitment to the organization. When work conflicts with family this is more troubling to women than men because motherhood is such a central part of their identity (Cleveland, Stockdale, & Murphy, 2000). Researchers have found that the extent to which women experience conflict between work and parental family responsibilities is influenced according to factors such as family relationships, social networks, and social status (Hagelskamp et al., 2011).

Recently, the continued relevance of role identity was reinforced by a study undertaken by Bimrose et al. (2014), who used grounded theory to explore the career support needs of older women. Their investigation of the career histories of such women was undertaken to see how it might inform future career support. Findings confirmed that for this group, social influences were the dominant influence, with socially gendered roles like 'homemaker' and 'carer' acting to constrain their career choices (Bimrose et al., 2014). The research also uncovered five additional themes as critically affecting women's careers:

- learning across a lifespan – how women engage in formal and informal opportunities to access and direct occupations
- multiple transitions (gaps caused by life events such as births, deaths, redundancy, divorce, caring) and how levels of resilience, adaptability and tenacity are used to respond to these
- intrapersonal influences – personal values and interests
- work influences – factors such as culture, which influence how comfortable women are at work
- financial influences – the extent to which choices are constrained by finances (ibid).

Two of these themes in particular – opportunities to learn and managing transitions - are associated with competencies needed for a successful career in that they contribute to career capital. However, career capital is found to operate differently according to gender (Duberley & Cohen, 2010; Juraqulova, Byington, & Kmec, 2015) with it operating as a positive resource for men and a negative one for women. One example might be domestic career capital, in the form of a supportive home life, which may have twofold benefits for men; allowing men both more freedom and capacity to work into the evening than it might offer a woman, and providing more authority or permission to justify long hours away from home life.

METHODOLOGY

Population and Sample

The career trajectory of men and women working as academics in STEM disciplines at the studied university bifurcate when moving from senior lecturer/researcher roles, to principal lecturer/reader roles. At senior lecturer/researcher level (Grade 8) the split between men and women is reflective of the gender ratio at the university (men hold, on average, approximately 60% of all of the posts at all levels open to STEM academics). At the next career level (Grade 9) the difference in the gender ratio increases, with men holding approximately 75% of those roles. See

Table 1 for an illustration of the roles which precede and follow the grade 8-9 bifurcation point.

Table 1: Grade and associated job role(s)

Grade	Typical academic job role
HPL	Hourly Paid Lecturer (short term contract)
6	Teaching Assistant, Research Assistant
7	Lecturer, Senior Research Assistant
8	Senior Lecturer, Research Fellow
9	Principal Lecturer, Senior Research Fellow, Reader, Associate Head of Department.
10	Head of Department, Associate Dean, Professor, Dean

The sample for this study were female academics working in STEM disciplines at the university. The aim was to generate a varied sample of participants. While not claiming to be generalisable, it offers insight into the problem being investigated (Patton, 2002). The target was to interview ten percent of the population of 214 women working at grades clustered around the split point of the career trajectory of men and women. Therefore this research set out to recruit female staff on grade bands 6 to 10, with a particular focus on women at Grade 8, given the lack of career progression between Grades 8 to 9. A wider focus than just this grade was taken in order to identify reasons which might develop before grade 8. Inclusion of women above Grade 9 was to elicit their insights about strategies adopted and support received which could prove useful and might facilitate learning which could be more widely adopted.

The call for participants was publicised through the university's online Daily Noticeboard. The two faculties with relatively high numbers of STEM disciplines also disseminated the request, via all-user emails to departments with STEM academics. Fourteen participants volunteered initially, and others were recruited by adopting a 'snowballing' technique – explaining the desired reach to volunteers and asking them to suggest other interview candidates. In total, 21 interviews were conducted with the targeted sample which was broadly representative of the population in terms of age, grade and discipline.

Of the 21 participants, 13 had dependent children living at home and ten held a PhD. Eighteen had previously had professional jobs outside the university and three had worked as academics throughout their career to date. Eight of the 21 reported being the main or only earner in their household. Table 2 shows other data illustrating the spread of ages, grades and disciplines of participants.

Table 2: Profile information for participants^a

Age	Number	Discipline	Number	Grade^b	Number
Under 30	1	Science	2	6	3
30-39	3	Technology	2	7	1
40-49	9	Engineering	7	8	10
50-59	7	Maths	3	9	5
Over 60	1	Medicine^c	7	10	2
Total	21		21		21

^aThis table is deliberately presented in this format to protect anonymity.

^bGrade 8 is the senior lecturer grade, and grade 9 is held by principal lecturers and readers with markedly fewer women than men at this grade.

^cThe Athena SWAN organisation includes maths and medicine as well as science, engineering and technology disciplines.

Instrument and Procedures

Ethical approval was granted via the university's review system, with institutional protocols observed to ensure participation was voluntary and participants were assured of anonymity. All of the interviews were conducted face-to-face and after introductions, the interview section lasted an average of 43 minutes. The interviews were recorded and transcribed verbatim.

The interview structure builds on the work of Bimrose et al. (2014) using the six previously identified themes as clusters for the research questions. The themes identified in previous research are actively investigated in a new interview setting, with new participants, to see if they are useful to characterise the experience of women of all ages, working in a particular job sector. In this way the work reported here takes a constructivist approach in that the perspective of previous research directs the attention of the current work (Charmaz, 2008). The interview format was semi structured in order to obtain 'descriptions of the real life of the interviewee' (Bimrose et al., 2014). However it is explicitly acknowledged that coding categories are pre-constructed by the researchers based on the detailed reading of the literature relevant to the subject of study (Willig, 2007). The coding categories are then used to map the experiences of the participants. The researcher then describes whether these align with the emergent theory (Walker & Myrick, 2006) rather than developing a new theoretical framework (Willig, 2007).

The interview comprised the collection of categorical data to ascertain the profile information of the participants. This was followed by prompt questions to explore the significance of themes previously identified as being important to the career stories of women. (The interview protocol is provided in Appendix A.) Two researchers then worked separately to code the interviews according to the extent to which they aligned with pre-identified themes and results were compared. In the case of discrepancies, a third team member was consulted. Coded data was then thematically organised against the framework proposed by Bimrose et al. (2014).

RESULTS

While the themes proposed by Bimrose et al. (2014) broadly matched the interview data, some amendments were introduced into the framework. With this amended framework, uncategorised material was minimal and insufficient to develop any further themes or sub-themes. The amended framework is found in Table 3. Analysis of the data is discussed under each of these themes.

Table 3: Themes associated with career support for women, as amended for use in a university context^a

Learning across the lifespan.

- *The importance of both formal and informal learning.*
- *The extent to which women use learning and training to access jobs and disciplines and how it directs and redirects their lives.*

Resilience, adaptability and tenacity - the responses to life transitions.

- *Continuity and change.*
- *Experienced stability through constructed networks.*
- *The impact of the family network to facilitate resilience.*

Intrapersonal influences

Work influences

- *Interpersonal discrimination.*
- *Structural influences.*

Financial influences

Societal expectations and influences

^aThe original main categories detailed in the Bimrose et al., (2014) article are underlined and in bold font. The developed subcategories are listed in bullet points. Amendments by the current authors are presented in italics.

Learning across the lifespan

Formal and informal learning opportunities were found both to be a key factor in the original research (Bimrose et al., 2014) and in this investigation. Within this category, two sub-themes were proposed. These sub-themes were divided between the importance of both informal and formal learning and how women use learning to direct and redirect their careers.

Importance of both formal and informal learning

Participants recognised the importance of learning, and limitations to career prospects if this was not taken up.

... because it is a ceiling in terms of how far you can get without it.

... because I want to be seen as relevant with other universities.

As a doctorate, or equivalent body of applied research outputs, is essential to be considered for progression to the roles where women are under-represented, specific questions were raised around this issue. The value of a PhD for career progression was discussed several times during the interviews.

... other colleagues that haven't [achieved a PhD], they almost have to prove themselves.

... 'Oh, I don't need to see how good you are at research'... because you've got [a] PhD.

The extent women use learning and training to access jobs and disciplines and how it directs and redirect their lives.

The second subcategory was amended to include how learning and training directs and redirects working lives. Training was introduced here as the participants discussed the necessity of institutional training for particular roles within the institution.

[Learning] ...it shows my experience... and it helps getting networking.

[Training] The interview course...helped me tons... in thinking 'I can do this job'.

[Training] ...when I applied for the management role I asked to go on the management course.

Resilience, adaptability and tenacity - the responses to life transitions.

The second category focuses on how women respond to transitions in their lives. While Bimrose et al. (2014) divided this theme between the continuity and fluidity of the lived experience and the stability experienced via constructed networks, this paper proposes there is a third sub-theme: the impact of the family support network.

Continuity and change.

Several participants offered positive examples of how they took an active stance to managing their time during their maternity leave:

...I was very proactive to make sure that I was building up experience, so I was getting the right boxes together, so I was getting the right profile to enable me to progress ...

...I would still like to keep in contact. I know it is probably not a part of the job and I wouldn't expect to be paid for it. But to have contact with the staff and to know what is going on... I would like to be kept in the loop.

Stability experienced through constructed networks.

Examples of positive line management which enabled support and stability were evident in the data.

... I had a fantastic manager who obviously wants the best out of you but was also very sympathetic as to the fact that you need to get that [life] balance.

I have just had some very good managers...I have had people that have trusted me and developed me ... have given me responsibility because they thought that I could grow

The impact of the family support network.

Several participants spoke of the network they had built to support their home life, either through a supportive partner or wider family.

My family, my husband has been fantastic. Without his support I wouldn't be where I am today.

...for the week I was delivering [marking], my parents came up for three of the five days.

Intrapersonal influences

The third category focuses on factors personal to women which influence work choices and satisfaction. With reference to working in academia, many of the participants spoke with passion about their work. They spoke of it providing intellectual stimulation, helping them achieve something, and make a difference in peoples' lives. Many spoke of the satisfaction of working with students being an important characteristic of their work.

I am passionate about the students... I know that a lot of people refer to the students as customers now, they are not ...

...it is nice when you can see somebody develop personally and emotionally, rather than just academically.

I want to be able to make some sort of a difference, it doesn't have to be huge... I enjoy working with the younger population.

For personal characteristics, individual drive and passion were dominant themes.

I want to drive and push myself.

For me, this is not a job. This is a way of life.

Work influences

The next category was workplace influences. This category was subdivided between interpersonal discrimination and structural influences. Interpersonal discrimination included bullying and harassment; behaviour identified by Bimrose et al. (2014). Structural influences represent barriers to career progression.

Interpersonal discrimination

Participants reported that where gender was a factor it was isolated to individuals: line managers making assumptions about the roles and capabilities of working mothers, deciding for them whether they would want to attend conferences involving an overnight stay, or adopting a patriarchal approach.

His exact words to me were 'I have a wife and three daughters, I am sure that I can manage you'.

The greatest discord expressed with their experience of work was with line managers, some of whom were perceived as having few interpersonal skills:

I have been even thinking of changing my employment because I keep on coming into too much friction with the top management, which is unpleasant. So I would rather work in a pleasant environment... do something perhaps more basic that does not require stress.

Two participants spoke of being required to act in a way associated with their gender.

If a man is assertive then that is seen as a positive thing, you know strong points of view. But if a women is assertive... they are just being awkward.

... I have been told off publicly a few times for being too assertive and saying inappropriate things when actually I just spoke my mind.

... they don't understand that ... they have these stereotypes in their minds that women who argue ... who don't have the standard viewpoint are just being difficult, are being deliberately inappropriate or whatever, whereas if a man does it then that is worth listening to.

Structural influences

Women also felt that, despite being the more likely person in a partnership to take a career break, they could not afford to ignore opportunities to progress, even if it was incompatible with family commitments:

I felt forced to apply for a Senior Lecturer post here a few weeks ago... I am not ready for the commitment of a Senior Lecturer but a few people [were] saying I have to be seen driving myself...

I feel obliged to and pressurised to, even though I knew it wasn't something that I wanted.

Financial influences

Finance was an important influence for those women who were the main or sole earner in their household. Eight out of the 21 interviewees reported being in this position, however, none reported it as a driving factor for their career.

For people not in this position, finance was featured less in their narrative.

I would like to stay on the same position, the same ... pay, but it [reduced personal income] wouldn't affect our lifestyle.

More money? Well you don't look a gift horse in the mouth, but do you know what would really make a difference is a clear network, a clear pathway of possibilities.

...actually I'd rather have a job that pays me less and have that less stress...

Social influences and expectations

Bimrose et al. (2014) identified social influences as dominating women's career choices and aspirations. In this study we added societal expectations. Expectations felt by women to be a carer for other family members are often offered as the single biggest constraint on career decisions and were highly relevant among the participants in this study.

...my mum [has] always been... if you have children... you don't work.

My parents were very supportive going to university and going into this career but as soon as family comes along that is what I should be doing.

Social influences in wider society, and subsequent internalised attitudes, cause barriers for women, especially those whose partners do not have flexible hours.

I thought I'd be full-time working full-time with my kids. I thought [of] course I can do that... the only thing that's changed is my attitude to it is, I don't want to do that.

...we have this Professor visiting us, let's join him for a drink and all my colleagues go off and then they will have a drink or seven or ten, but I can't do that.

They almost have a clocking in and a clocking out, so he [partner] has to be there at quarter past 8, irrespective of whether he is [----] or not. He has to be there until 5 o'clock, irrespective of whether he is [----] or not. So in terms of running ... the children to school, then it is impossible, yes. And picking them up is impossible.

I mean he [partner] never, ever does anything like going to the dentist, or if the school ... did ring because one of them was unwell it was always me that would leave work.

As a result, flexibility and the requirement to manage non-working time to match family commitments remain critically important to women with families.

...it is important that you have got flexibility with your start and finish time. I would say it is essential.

...working late into the night, writing reports and I am thinking oh my God and I did not think about that when I was putting in for progression...

DISCUSSION

This study investigated individual perspectives of women working in STEM roles at a UK university to understand the factors that affect progression. The context is the persisting gender inequity observed in STEM disciplines in Western societies, and at the study university this was found to be poignant at the point of progression into senior roles. Despite policies designed to encourage equality of opportunity, challenges are still found in the lived experience of women working at this university. In this section we examine the validity of the framework used as a tool to illicit meaningful conversations with individuals to understand the issues underpinning this inequality (Bimrose et al., 2014) and explore the extent to which the results correspond with other relevant literature in the field. The results are then discussed in terms of their value to policy and practice.

Performance of the framework

The original framework resulted from research exploring the career stories of older women generally, and here it has been used in a specific context, with women of a more heterogeneous age range. The framework was found to be a useful structure to elicit factors both internal and personal to women, and those that are more in the remit of an employer to address. Estimation of the relative importance of each theme quantitatively is hampered by the extent to which the schedule did not contain equal numbers of questions to address each theme. Of the six dominant themes categorised in the original study, five generated engaged discussion with women of a range of ages and career stages. The themes which prompted the most discussion were management of multiple transitions (gaps caused by life events such as births, deaths, redundancy, divorce, caring) and work. The only theme to

generate little response was around finances. It may be that needing to earn, or having sufficient to live on, for this group is a given and therefore operates at a background level.

Our results show how the headline themes appear to be open-ended enough to enable broad ranging topics to be discussed and elicit information useful for understanding and addressing the disparity of women at senior levels. Examples of challenges which emerged unprompted from the interviews were inconsistency of advice about progression, and the importance of encouragement by a line manager.

Sub-dividing two of the categories enabled recognition of nuanced differentiation between, in the first instance, having learning, and secondly being able to generate career capital or progress as a result of having learning and training. These are separately conceptualised by participants, with the latter not always followed through. The number or level of qualifications which were desirable to hold appeared from the data to be separately conceptualised to notions of the extent to which women *use* their qualifications and training opportunities to drive career opportunities.

There is considerable triangulation between our findings, those of the research which it followed (Bimrose et al., 2014) and factors identified in other literature as pertinent to gender disparity in science-oriented and/or senior career paths. The interviews with women align with Ashcraft's (2001) argument that some of the soft skills required of lecturers, such as communication and empathy, were those which attracted participants to their posts, and which they are reluctant to give up in order to take on managerial roles.

Women interviewed in this study acknowledged there was a long term career penalty for stopping work or reducing hours for a period. This aligns with the work of Cabrera (2009), who identified that the ability to temporarily reduce work without long term career penalty would be attractive. Those participants in this study who seemed to cope best had deliberately managed this phase of their lives themselves, rather than waiting for the university to provide support. This aligns with the findings of O'Meara (2015), who found that women with agency were more able to overcome career progression barriers, and with Duberley and Cohen (2010) who observed that the extent to which individual women could exploit their strengths and opportunities was constrained by their perception of what was possible. It also corresponds with a recommendation following development of the framework (Bimrose et al., 2014), which argues that women could benefit from regularised career support for their non-linear work careers, rather than relying on friends, colleagues or family for advice.

There was also clear evidence in the stories of participants of their manager's own workload and pressures affecting attitudes towards part-time work by subordinates. This is in line with Gregory and Milner's (2011) argument that flexible working in the UK is rarely an entitlement and not always viewed favourably by managers. As discussed in the previous section, the freedom to work part-time is perceived by women both below, and at, management level as being incompatible with

progression to a senior role. It has been documented in France (Windebank, 2012), that career breaks for parenting is a factor associated with lower wages and more job insecurity. In particular, when these exceed six months, they have a long-term negative effect on women's career trajectories. The stress associated with work overload, unsatisfactory communication and poor management was also clearly documented by participants and aligns with previous work with academics in the UK (Kinman & Jones, 2008). The frustration of paternalistic management, gatekeeping activity over networking opportunities or the holding of social events out of work time triangulates with the findings of White (2014). White identified this type of discrimination as 'in keeping' with the traditional male gendered vision of the ideal single-focus scientist free of other responsibilities.

Also, as highlighted previously, women highly value the flexibility that allows them to continue their careers. But when they have a partner not working in academia it can also act to restrict opportunities, because the university-employed partner is perceived to have more opportunity to take up family responsibilities. This indicates a potential rebound effect for the policy and illustrates an example of an argument that accumulation of economic, social and cultural capital can enable men but operate negatively for women (Duberley & Cohen, 2010; Juraquova et al., 2015).

While career barriers identified by participants accorded with the framework, there was clear interaction between many of the themes. Interaction, or moderation, is the effect of one factor magnifying, attenuating or cancelling out the effects of another (Hoyle & Robinson, 2004). An example of a workplace factor magnifying the impact of a factor personal to the individual was given by a participant recalling how their sense of their own resilience was weakened by negative comments from colleagues about absences or their part-time status. There was also considerable interaction between work and family responsibilities and the capacity of women to take up opportunities to develop their careers using learning.

The framework used in this study has proved a useful structure for eliciting narrative accounts to inform policy around equality of career development. However, it also suggests that policy alone has little impact on the lived experience of the individual and the realisation of the policy ethos by the local manager is key to addressing gender inequality. The complexity of competing issues and unorthodox pattern of women's careers is acknowledged to mean that no framework can offer generalizable answers (Bimrose et al., 2014). A further indicator of the efficacy of the amended framework is that, while not all of the interview material could be categorised according to the themes explored, there was insufficient of this uncategorised material to suggest new or sub-themes.

Value to policy and practice

The current work was able to elicit feedback from the experiences of participants to inform local policy. In line with the literature, several factors which surfaced as a result of the framework's use are clearly socially located and personal to women, thus outside the scope of an employer to address directly (although as noted in the previous section work-based factors can attenuate or magnify the impact of these). The stand-out personal issue, for instance, was having a particularly supportive

partner who could also work flexibly, or parents who could help with childcare. This suggests that women without this support feel less able to take on a management workload and to continue to develop their careers. It also appears that the flexibility offered by the employer, while being helpful to employees with families, can have unintended consequences. Women who work for the university, who have partners who do not, feel obliged to call upon the flexibility on offer and take on main carer responsibility because of the opportunity offered by their employer. One action the employer might consider is to reinforce in its communication that flexible working is equally available to men and women.

As well as seeking to understand the factors affecting progression from an individual perspective, we also asked participants for their experience of the functioning of existing supportive work/life balance policies. There were several issues external to the individual which emerged, which indicate that women's capacity to manage career breaks and part-time working is constrained by their experience of the workplace culture and expectations of their predominantly male managers. Support actions could concentrate on minimising the effects of job scarring from having a maternity break and enabling actions which encourage women to stay engaged in their career during periods of part-time working.

Participants spoke of a culture where a working pattern of fewer hours than the 9-5 'norm' is viewed negatively by colleagues and line managers. During this period, which could last several years, part-time workers are more likely to 'tread water' with their careers unless they receive pro-active institutional support and encouragement from their line managers. Actions that an employer might make include reviewing the operation of the flexible working policy to ensure it is embedded into working systems rather than bolted onto a default 9-5 work pattern. Other actions identified involve allocation of resources for and ensuring consistency at line management level of proportional workloads for fractional posts. Line managers might also benefit from training so that management behaviour is consistent in preparing staff entering a maternity break with an exit and return interview, to incorporate discussion about level of involvement sought by the staff member during the break, if any.

Some women clearly managed to negotiate maternity breaks and part-time working more successfully than others. Resilience, tenacity and adaptability were identified as helpful to success in previous research (Bimrose et al., 2014). These characteristics are also a strong feature of the stories of the women participants in this study who have successfully taken the initiative to forward plan, to organise and to have clear strategic goals. The requirement for resilience as provided by a supportive network was found to be critical on two sites – within the university, and also for life outside work. While these were both discussed by participants, they were spoken of separately. Though developing these networks require similar capabilities, they were not equally recognised by some of the participants as being part of the package of support a woman needs to build. Employers could investigate the potential to learn from women who have successfully negotiated career breaks and part-time working, and develop mentoring support which gives women advice on how to manage their maternity leave and return. The freedom to work part-time

is perceived by both women below, and at, management level as being incompatible with progression to senior roles. A further policy recommendation is the investigation of the potential for high quality after-school support as well as nursery care, to enable staff to work full-time, should they wish to.

As might be expected, women working in the higher education sector are motivated to use learning to develop their careers. However a key barrier to exploiting this opportunity is time. Women on part-time contracts, in particular, appear to sacrifice personal development opportunities as a way of meeting commitments at work and at home. There was also inconsistency of support and encouragement to undertake training and development opportunities. Some participants reported supportive and encouraging line managers, while others found little guidance and little accommodation for part-time working. An action an employer might take is to explicitly encourage a pro rata amount of time spent on personal development compared to full-time staff and incorporate an overt and proactive discussion of this in development review meetings.

A key workplace influence revealed by using the framework was a perceived inconsistency in the quality of line management and interpretation of university-wide policies. This is also congruent with the findings of the House of Commons Science and Technology Committee (2014), which recommended that line managers should be required to undertake management training on appointment, to include diversity and equality issues, including an understanding of the rationale behind key policies such as flexible working. It should be noted that the university which was the focus of this study has this type of policy in place, further illustrating the observation that organisationally the UK is typically strong on policy, but needs to be equally strong on producing results from such policies. To date, the impact of such policies is patchy both within and between organisations. Schiebinger (2008) observed that when policies exist but are weakly enforced, it is not just ratios of women in management positions that needs attention, but that further work is required to address the culture of the organisation. Commitment from the university to engage in the Athena SWAN initiative appears a promising vehicle to support and encourage changes in culture and attitude, as has proved successful elsewhere (Munir et al., 2013).

Our literature review focussed on the triple jeopardy facing female STEM academics; gender challenges in careers of university staff generally, plus those associated with science careers, and also those associated with progression. Further, interaction between themes was noted during analysis of the framework. The complexity of the challenge is reflected in the stubbornness of the disparity figures. Required is a sophisticated mix of new processes with existing systems and policies to act as the catalyst that will encourage a series of micro-adjustments such that female STEM academics are exposed to a continuous narrative and experiences that encourage, enable and support their career progression. Given our participants reported negativity from some peers and line managers around equality provisions we see a particular opportunity to widen the narrative about gender disparity from being about equity for individuals in the workplace to

focussing on the benefits of taking a deliberately gendered approach to future science research as Schiebinger (2008) has begun to demonstrate in the US.

A limitation identified in this study is that 21 women, all of whom volunteered to participate, may not fully reflect the population of female STEM academics. Comparison interviews with male members of staff weren't conducted and this would be a useful addition to reflect on whether the issues raised are truly singular to female members of staff. One particular avenue to investigate is the value attached to 'masculine' skills. Senior level appointments, which might potentially remove or reduce the capacity to nurture the development of students, was less attractive to some participants. Specific investigation of this issue could be undertaken to see how it might further explain how work influences career progression differentially according to gender. Further research is also recommended, particularly in a university setting, into exploring the separate conceptualisation we identified among the participants, of the skills sets involved in acquiring learning and skills, and those for capitalising on them.

This study addresses the notion that issues at the individual, or micro level, are less understood than issues at the organisational, or macro level (Duberley & Cohen, 2010). While this study addressed issues at both levels, they were viewed from the perspective of women considering progression. Further research could simultaneously consider tackling gender disparity from the perspective of the institution as well as female (and male) employees.

CONCLUSION

To our knowledge this is the first study of its kind to test the applicability of the Bimrose et al. career adaptability framework (2014) in an applied setting. The revised framework presented in this study offers a potential vehicle to investigate the persisting problem of gender disparity in progression for STEM disciplines within universities. By assessing challenges and barriers from the perspective of the individual such interventions are designed to support, we provide an alternative perspective to the majority of research which focusses at the level of the institution. We believe the amended framework is relevant to other academic institutions when focusing initiatives and moulding new interventions. The results of studies such as this can be used to inform policy makers and implementers about the extent to which policy is meeting its intended purpose and identify new avenues for action. Future work might also see the framework applied in other disciplines in which women are under-represented at senior levels.

Discussions brought to the surface a number of potential policy adjustments required at the level of the employer and also insights on offering a supportive environment for factors internal and personal to women. The stand-out personal factor which helped women develop their careers was when they expressed confidence in their capacity to plan and to develop their own strategies to manage periods of absence or part-time work: those with strong support networks appeared to be more satisfied with their career trajectory. We would advocate that the notions of career confidence and adaptability (e.g. Fiori, Bollmann, & Rossier, 2015), women's sense of capability to make positive career decisions and adopt

positive self-development strategies (e.g. Duberley & Cohen, 2010; O'Meara, 2015) are competencies to be further investigated and nurtured in order for an employer to address gender disparity at senior levels of the workforce.

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