

Female Attrition, Retention and Barriers to Careers in SET Academic Research

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The UKRC

Introduction

This summary report has been produced by the UK Resource Centre for Women in Science, Engineering and Technology (UKRC) as part of the 2009 L’Oreal UK and Ireland Fellowships for Women in Science Programme.

The programme awards are offered by L’Oreal UK and Ireland with the support of the UK National Commission for UNESCO, the Irish National Commission for UNESCO, the Royal Institution of Great Britain, and the UK Resource Centre for Women in Science, Engineering and Technology. Four Fellowships are awarded to outstanding women scientists in the early stages of their career to enable and facilitate promising scientific research in the fields of the life or physical sciences.

Programme award winners testify to the valuable assistance of the Fellowships to their career advancement in terms of increased confidence, collaboration and credibility. The flexibility of the funding has enabled the awards to support both returners to scientific research and those beginning to establish a base for future independent research funding.

This paper looks at the issues impacting on women’s career progression in academic research in scientific disciplines, which highlight the continued importance of positive action to ensure women scientists can achieve their full potential.

Renewed focus has been given to the career support of researchers through the launch in 2008 of the Concordat to Support the Career Development of Researchers in the UK. This agreement builds on the Research Careers Initiative following the original “Concordat on Contract Research Staff Career Management” signed by the funders and employers of researchers in 1996. The new Concordat enables the UK to align with the European Charter for Researchers and continues to support actions flowing from the Roberts Report (2002)

The UK universities’ ‘Concordat’¹ on the management of fixed term research staff (1996) and the Roberts Report (2002) put the issue of contract research firmly on the UK policy agenda over ten years ago, and initiated important changes in relation to career progression, including more competitive salaries for post-doctoral researchers, better training and support in institutions, and the provision of new career-track independent fellowships across the STEM subjects and beyond (Garforth and Kerr, 2009). The 2002 Fixed Term Employees Regulations reshaped the legal context in which universities operate as employers with a responsibility to avoid treating fixed term staff

¹ In 1996 a Concordat on the career management of contract researchers in UK universities was published (CVCP, 1996). Subsequently, concerns over poor career structures and prospects for postdoctoral researchers, specifically in science, engineering and technology, and the consequent problems of recruitment and retention, featured strongly in a recent UK Government review of the employment position of scientists and engineers (Roberts, 2002).

less favourably than permanent workers (Garforth and Kerr, 2009). Whilst these changes in principle represent positive steps, they remain difficult to implement (for example, CST Report, 2007), and a number of other barriers to successful careers in research, particularly related to gender discrimination, remain unresolved.

This report looks at the evidence of the barriers faced by female researchers at the early stages of their academic careers² and women returning to research careers in Science, Engineering and Technology (SET) disciplines. The importance of grants and fellowships for researchers is also discussed, but not information on the availability of grants and fellowships. This report is principally based on the empirical research from the UK (although evidence from other countries is occasionally used). It provides data on representation of female and male academic researchers, and a literature review of the barriers faced by women researchers in the academia. The report does not provide information about different initiatives set up to improve position of female researchers, nor recommendations, or a detailed contextual analysis. These are beyond the scope of this report and may be found in a number of government reports, EU sponsored work, as well as work, organization, and feminist science studies literature.

As the report discusses negative aspects of research careers, it should be noted here that academic research is generally viewed as enjoyable and intellectually rewarding by both female and male researchers (for example, Garforth and Kerr, 2009; Lober Newsome, 2008a and b). Most researchers are very proud to be scientists and possess strong culture of 'vocationalism'. For many moving out of academic research would involve not only taking one's skills and knowledge elsewhere, but also a good deal of work-related identity (Garforth and Kerr, 2009).

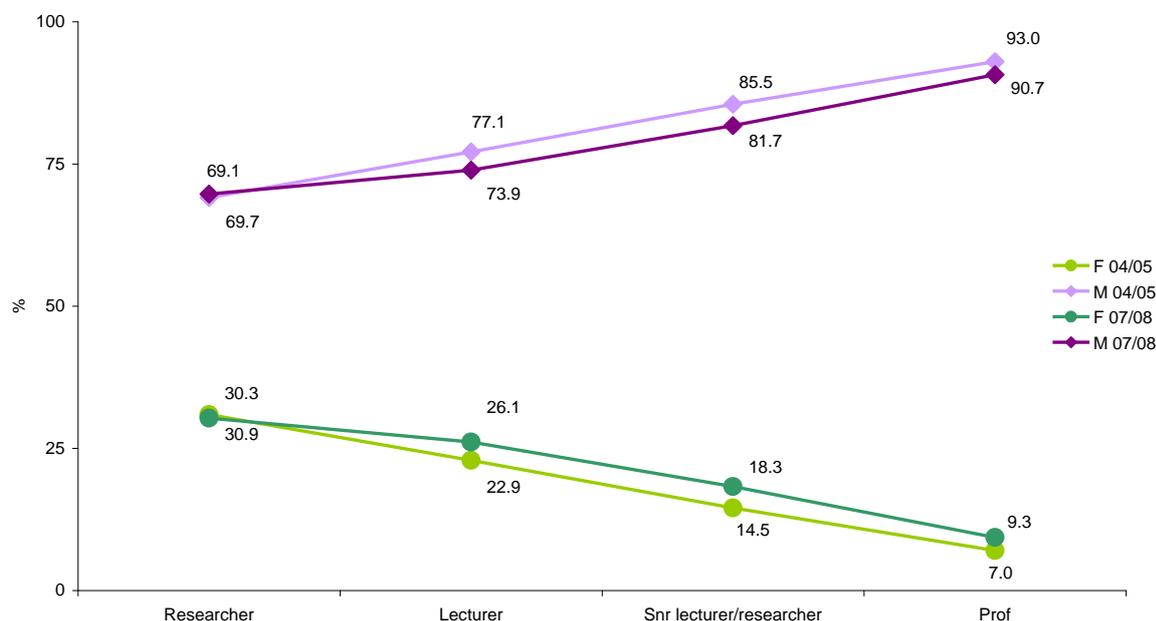
Statistics on academic career progression and the representation of female and male researchers in academia

Vertical segregation

Women are still less likely than their male colleagues to advance to the senior positions in academia, despite their growing numbers in the SET undergraduate and postgraduate courses since the 1970s. This sub-section shows career progression of women academics in HE science, engineering and technology departments by showing the actual number of women and men at each academic career stage from researcher to professor level over time, and analyses this as a percentage of the total numbers at each stage (Figure1).

² Phrase "early career stage" researcher, rather than 'young' researcher, is used throughout the report to underlie the fact that many women may remain at an "early stage" of their research career well into their 30s or even 40s, due to factors such as career breaks. Discussed in UKRC Note (2008).

Figure 1: The career progression of women and men in the HE science, engineering and technology departments, 2004/05 and 2007/08



Secondary analysis by UKRC

Data source:

HESA (2008) Resources of Higher Education Institutions 2006/07. Cheltenham, HESA.

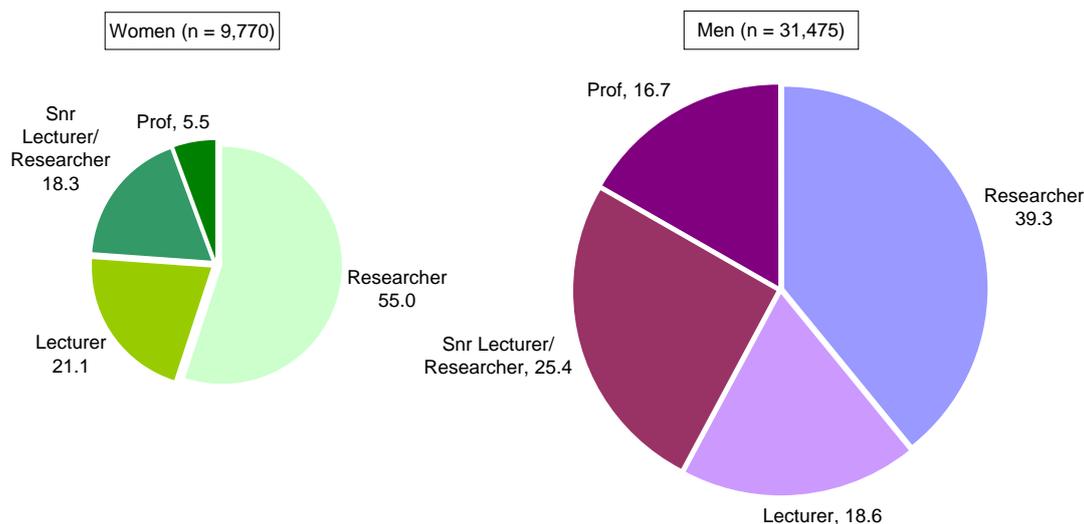
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Figure 1 shows the differing proportions of men and women at four main stages of a university career; from researcher on the left, to professor on the right. The two purple lines show the men as a percentage of all staff at each grad for each of two different years 04/05 and 07/08. The two green lines show the same data for women. The divergence of the lines year on year gives a good indication of the fact that at each level of seniority there are a smaller proportion of women than there were in the level below. However, it is important to note that this is not data showing the same cohort of people over time. It is a snapshot of the distribution of staff in two different years.

As shown in Figure 8.1 women academics and researchers in SET disciplines are not reaching the senior levels of the profession in the same proportions as their male colleagues. While 5375 women researchers make up roughly 30 per cent of researchers in SET academic departments, they are a smaller proportion of lecturers (26.1 per cent, or 2065 women) and senior lecturers/researchers (18.3 per cent, or 1790 women). The leaky pipeline is particularly in evidence at the transition from senior lecturer posts to the professorship with only 540 (or 9.3 per cent) female professors in SET departments. The decline in the female proportions at each career stage holds irrespective of whether women are in a faculty with a 'critical mass' of female students and researchers, such as biosciences, with 2270 women accounting for 45.9 per cent of researchers but only 15.0 per cent of professors (165 women), or disciplines where women remain severely under-represented at all stages of academia, such as mathematics, with 135 women being 20.3 per cent of all researchers and a tiny 4.4 per cent of professors (30 women). To examine where the bottlenecks in the career progression of academics are

Figure 2 shows proportional distribution of women at each stage of academic career in SET (green pie chart on the left hand side), while the purple chart (on the right hand side) shows the same type of information for men.

Figure 2: The proportional distribution of women and men at four stages of academic careers in SET, 2007/08



Secondary analysis by UKRC
Data source:
HESA (2008) Resources of Higher Education Institutions 2006/07.

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Women predominate at junior researcher posts

Figure 2 shows that women remain concentrated at more junior positions with about 55 per cent of all women in academia in research posts compared to 39.3 per cent of all men at this level. At the other end of academic hierarchy, only 23.8 per cent of all women in SET departments are professors and senior lecturers, compared to 42.1 per cent of all men. This situation has not improved significantly for some time, which challenges the notion that a 'critical mass' of women in the lower ranks of a profession should necessarily lead to a greater gender equality in the more senior academic posts.

Contract Research Staff (CRS) predominates in SET disciplines

In 2006/07 the overall number of research-only staff in UK HEIs was 35,282 (Contract Research Staff, including 46 per cent women), and 9,150 (Permanent Research Staff, including 48 per cent women) across all disciplines. The percentage on fixed-term contracts has been declining (following implementation of the Fixed-term Working Regulations which came into effect in July 2006), but it remains relatively high in SET disciplines: 84 per cent of researchers have CRS status in biosciences, mathematics and computing, and physical sciences, and 86 per cent of researchers have CRS status in engineering and technology, and architecture, built environment and planning (UK Research Base Funders' Forum, 2007).

Evidence of barriers to successful research careers

Barriers to research careers perceived by PhD students

The experiences and opinions of PhD students are included in this report, because doctorate students are the main source of potential researchers. The findings of the survey carried out by the Royal Society of Chemistry, for instance, showed that women in chemistry were increasingly deterred from pursuing research careers as they progressed through their PhDs with the proportion of women wanting to carry on in research reduced from 72 per cent to only 37 per cent between the first and third year of their doctorates (RSC, 2008).

A study of chemistry PhD students at 3 universities in the UK (Lober Newsome, 2008a) showed that the participants of focus groups (mostly women but not exclusively) were reluctant even to begin the post-doctoral research process. Three main reasons provided included, firstly, modest pay, aptly expressed by one second year female student, with general agreement among focus group participants: "This may sound shallow, but it's a lot of work for not very much money". Secondly, the short-term nature of contacts and few possibilities for advancement to a more permanent post; the problem summarised by a post-doctoral graduate: "I don't want to end up on the track where you're just post-docing for years and never get any further." Thirdly, a possible need for relocation at the end of each contact. These findings give a certain degree of insight into the factors that deter young women from careers in research. Next section discusses post-doctoral researchers' views on the barriers to research and academic careers.

Barriers to research and academic careers faced by post-doctoral researchers

A substantial majority of PhD graduates who aspire to academic posts in sciences begin their careers as contractual research staff (CRS) before they are considered for more permanent posts of lecturers or independent research fellows. This process is progressive, continuous, and with a single upward trajectory (Garforth and Kerr, 2009). The research posts mostly come with fixed short-term contacts, low organizational status compared to permanent academic positions, and low pay relative to other forms of employment adequate to researchers' level of education and expertise. It should be noted here that many of the factors discussed below are pertinent to both women and men, but the multiplicity of factors affecting work life balance and the interplay between them is often decisive only in the case of women.

Short-term fixed contracts and employment insecurity

The insecurity of being on a fixed-term contract presents a major barrier to full enjoyment of the jobs in academic research (Oliver and Ackers, 2005). For example, an AUT survey of academic staff showed that nearly half of respondents on fixed-term contracts felt fairly or very insecure in their current job, whilst only 9.8 per cent of those on a permanent contract felt fairly or very

insecure (Association of University Teachers, 2004). The findings of the Academic Research Careers for Scotland (ARCS) survey indicate that the job insecurity was manifest in two ways: firstly, the lack of short-term security when future funding remained uncertain; and secondly, the lack of long-term security, in terms of being able to build progression into a career and plan for long-term commitments (the ARCS survey, Warwick Institute for Employment Research, 1999, discussed in Oliver and Ackers, 2005). Moreover, short-term contracts have a negative effect on recruitment and retention of academic staff (the UCEA survey in Thewlis, 2003).

'Permanent' contractual status

The short nature of the post-doctoral research (post-doc) contracts is not necessarily a problem, particularly for researchers without families, if they manage to secure permanent positions after a period of a couple of years. Post-docking may, for example, provide researchers with broader perspectives, new contacts, and opportunities to work on interesting projects. As described by one PhD chemistry graduate: "With post-docking you're out of a job one month and in another one a next. But that's never put me off. You get to move around and you get a lot of variety. It keeps things interesting." (Lober Newsome, 2008a)

Contractual post-doctoral research, however, turns often into a long 'training' phase, particularly in sciences, where many post-docs work continuously on short-term contracts for many years. Newman (2008), for example, reported that 70 per cent of post-docs in the School of Biological Sciences at Aberdeen University had been continuously employed for six or more years on fixed-term contracts. Also Garforth and Kerr (2009) indicate that researchers in biological sciences who had not moved up or moved out of academic research after one or two post-doctoral posts find themselves in an anomalous position of "perennial post-docs". This situation is not officially supposed to exist, and long-term post-docs risk becoming invisible to the institution and their opportunities for career progression become very limited. Some biological sciences participants of Garforth and Kerr's study expressed frustration at what might be perceived as the downgrading of professional research work to 'training'. These experienced post-doctoral researchers were involved in running the experimental side of projects, supporting post-graduates at the bench, in communicating their research and contributing to writing research grants - as well as attempting to build an academic name as a legitimate knowledge producer in their own right by publishing research articles. Bothwell (2007) summarises the situation well by saying that "the minority who stay in academia can all too easily find themselves locked in an endless cycle of sequential postdoctoral contracts. Of these, a small number will break out to become independent fellows and secure their own funding". She reports that an estimated 70 per cent of research staff aspire to become professional academics at the start of their careers. However, after a few years experience this number drops to under 50 per cent.

As discussed in the statistics section, although women are under-represented across a whole academic hierarchy in SET disciplines including post-doctoral level, they congregate at the 'junior' researcher positions, and are less likely to

be promoted than their male counterparts. This means that they are more likely than men to remain in the post-doc cycle over many years.

Low organizational status

Contract researchers often suffer from lower organizational status compared to permanent academic staff. For example, Garforth and Kerr (2009) report that in the biological sciences there seemed to be institutional and departmental tendencies to segregate contract research staff (who were often located in separate office spaces from the core department) from colleagues in the academic department, at the risk of making them further invisible to the institutional centre. They also reported accounts of contract researchers being treated by permanent core-funded colleagues as marginal and peripheral. During the participant observation phase of their research some contract researchers commented on their official designation as '*academic-related*' rather than '*academic*' staff within higher education organisations. This undermines contract researchers' work-related identity and status.

Modest Pay Levels

Low pay relative to other forms of employment adequate to researchers' level of education and expertise contributes to financial insecurity and feelings of being under-valued. For instance, modest pay was one of the factors behind chemistry PhD students' reluctance to consider academic research as a career option (Lober Newsome, 2008a).

Long-hours cultures of research particularly in sciences

Garforth and Kerr (2009) in a study of biological sciences report that women post-docs were particularly reflexive about the gendered trade-offs around work and life that academic roles involved. They were much more likely to be critical of the long-hours culture and the vocational demands of academic life. Also, participants of an UEA research staff survey reported that the SET bench culture of long hours demanded a high level of presence as a measure of commitment (Athena, 1999). Detrimental effect of long-hours culture on women with families is discussed next.

Family obligations

Family considerations constitute a major deterrent to careers in research, as at that stage the critical ages for academic career development and family building coincide, forcing researchers to make choices and/or compromises. Evidence further shows that these choices, challenges and/or compromises are faced mainly by female researchers (Universities UK, 2008; Martinez, et al. 2007; University of Leeds Report, 2002; Whitelegg, et al. 2002). For example, Martinez, et al. reports that 42.5 per cent of male researchers in their sample stated that a spouse or relative cared for their children during the day, but only 15.5 per cent of women had this option. Similarly, 71.5 per cent of men and only 25 per cent of women said that a spouse or a relative took care of their children after school. Furthermore, 30 per cent of men expected their spouse to make concessions compared with just 15 per cent of women. The literature shows that these facts alone constitute a professional advantage for male researchers (Kirchmeyer, 2006, Martinez, et al. 2007).

Most women need to make choices between research/academic careers and a family, and some women choose not to have children in order to avoid damaging their careers. Many women in the chemistry PhD study perceived post-docking as incompatible with having a family (Lober Newsome, 2008a). And indeed fewer women than men academics have children (Leeds University Report, 2002; Hawkins, 2002; Whitelegg, et al. 2002; Athena, 2008). Athena Survey of Science Engineering and Technology (ASSET) showed that male respondents across all levels of academia (56 per cent) were significantly more likely than women (45 per cent) to have children. Proportions of researchers with children differed between different disciplines. For instance, only 36 per cent of female physical scientists had children compared to 42 per cent of their male counterparts (Athena, 2008).

Not surprisingly women are more likely than men to foresee family responsibilities as a possible source of conflict with their future professional life. Martinez et al. (2007) reports that more than 21 per cent of women researchers, but only 7 per cent of men, said that plans to have children, or to have more children, were extremely important considerations in planning their career. Similarly, spending time with family members other than children was considered to be extremely or very important by 40 per cent of women, but by only 25 per cent of men. Moreover, 57 per cent of married female post-docs who did not yet have children, and more than 36 per cent of single women—compared with 29 per cent and 21 per cent of men, respectively—rated having children as a very or extremely important factor influencing their career choices. Findings of the study at the Faculty of Biological Sciences, Leeds University showed that women researchers with small children felt their career progression was slowed because they were exhausted, and thus unable to compete with men (University of Leeds Report, 2002).

The problems of combining family and academic work are already clear among PhD students. The findings of the two studies exploring attrition of PhD students in chemistry and biosciences from future careers in research (Lober Newsome, 2008a and b), show that women were less likely than men to want to stay in academic science in the long term. A perceived incompatibility between an academic career and motherhood and/or maintaining a work-life balance were cited by many as reasons behind that decision. In biosciences only 47 per cent of female respondents compared with 62 per cent of male respondents believed they would have a long-term academic career. In chemistry the finding was even more pronounced. 72 per cent of first year but only 37 per cent of third year female chemistry PhD students indicated they wanted to stay in research after their PhDs. This pattern was not found among male chemistry PhD students (Lober Newsome, 2008a).

Evidence gained from post-doc researchers provides a further insight into the hurdles encountered by women in academic research. In the study by Whitelegg et al. (2002), when asked to forecast how their careers might develop in future, most of the young women physicists interviewed raised issues concerned with the difficulties of combining working with raising a family. Female researchers reported that work in a lab was not conducive to having a baby or to raising a family mainly due to the need to spend long

hours running experiments in the evenings and at weekends. Furthermore, the general perception was that it was very difficult to take maternity leave whilst being funded by a research fellowship for a postdoctoral project.

Moreover, women often seem to be forced to take 'less ambitious route'. For example, Martinez, et al. 2007 reports that more than two-thirds of the male researchers but one-half of the female researchers in their sample said that they were considering a Principal Investigator (PI) position. Among all research fellows, those who were married with children were the least likely to consider becoming a PI, and within this group, women were even less inclined to become a PI than their male counterparts (Martinez, et al. 2007). And indeed evidence suggests that having children may have a negative effect on women's probabilities of tenured jobs and full professorships. Ginther and Kahn (2006) report that single women in academia do better at each stage than single men, and that children make it less likely that women in science will advance up the academic job ladder beyond their early post-doctorate years, while both marriage and children increase men's likelihood of advancing.

Women who have a family, or intend to start a family, often decide to look for career options outside academia. As reported by Whitelegg et al. (2002), female physicists they interviewed wanted a career that enabled a life outside work and the opportunity to have a family, and they thought that post-doc posts rarely provide this opportunity with their long hours and the insecurity of short contracts.

Insufficient provisions for part-time work and job/contract sharing

Two of the ways to ease the burden of combining work with family obligations, are part-time working and job/contract sharing arrangements. Women researchers are generally very keen on this option, despite possible detrimental effects on their career (Martinez, et al. 2007; Leeds University Report, 2002; Athena, 1999). The findings of a study at the Faculty of Biological Sciences, Leeds University, for instance, show that many women participants wanted the option of part time academic posts at least as a short-term solution when domestic duties were incompatible with full time employment. Men in this study were also interested in part-time working, and almost half of the male respondents who expressed an opinion (77 per cent of the total) also wanted the option to work part-time at some stage of their career (Leeds University Report, 2002).

However, findings of the Faculty of Biological Sciences study point to the commonly held view among senior managers that part-time academic posts are untenable. Holders of such posts were felt to compromise their chances of promotion by being unable to compete on the research side (Leeds University Report, 2002). Furthermore, Whitelegg et al. (2002) reported that female researchers in physics were not aware of part-time opportunities in their field of research work. There was also a perception that part-time working was likely to carry less responsibility and so there would be fewer career development opportunities. Those who did put family before career reported that they did so with the understanding that they may not be able to pursue a

research career at all and may have to change profession. Those that had already moved out of research to other areas such as journal publishing or working in a hospital lab felt there was much more flexibility that enabled them to work from home or go part-time if they wished (Whitelegg, et al. 2002).

Further evidence for the barriers to part-time work in academic research came from the EC sixth Framework Programme project KNOWING (Garforth and Kerr, 2009). Garforth and Kerr report that female researchers in biological sciences favourably perceived temporal flexibility provided by research careers, but reported that this flexibility came along with symmetrical inflexibilities in the way that academic work is evaluated and assessed. Female respondents in this study, commented for example on the fact that despite formal recognition given to part-time hours and career breaks in recent iterations of the Research Assessment Exercise (RAE), informally they felt that normative expectations of productivity and output, linked to the masculine norm of the full-time unbroken career, remained unchanged.

Insufficient support for women on maternity leave and sick leave

Almost all fixed-term contract-based research positions are largely funded from short-term external income sources managed by Principal Investigators (i.e., not core HEFCE funding). It has been reported by Oliver and Ackers (2005) that the Concordat has encouraged funding bodies and research councils to make provisions to cover for maternity leave and sick pay to members of contract research staff (who fulfil the relevant qualifying conditions of the employing institution). In practice, however, provisions vary significantly at institutional level and between resource centres both in terms of the financial support for these situations and the possibility of extending the duration of grants (Oliver and Ackers, 2005). Female researchers are often reluctant to consider starting a family because maternity leave would mean a significant disruption to their research careers. This finds support in research by Whitelegg, et al. (2002) who reported that the general perception among researchers in physical sciences was that it was very difficult to take maternity leave whilst being funded by a research fellowship for a postdoctoral project. The authors point out that if time is taken from a research fellowship at postdoctoral level then the grant might have expired before the project was completed. In addition, because research is assessed by the number of research papers published, the production of fewer papers would damage a researcher's record. There is also a lack of support for women returning from maternity leave. Research at the Faculty of Biological Sciences, Leeds University showed that although maternity leave was acknowledged by senior managers to be detrimental to women's career progression, no evidence of positive action to ameliorate this was found (Leeds University Report, 2002).

Barriers to mobility

In 2000, the European Commission highlighted the need for greater mobility among researcher community between the EU member states. Increased mobility has a major role in establishing networks of researchers across the EU, it allows for new ways of thinking to develop, and supports the academy in its pursuit of greater knowledge and new discoveries (Universities UK, 2008). It also raises significant barriers to the careers of female researchers,

particularly amongst those who are partnered with other mobile researchers, which have not yet been addressed by policy-makers within the EU (Universities UK, 2008).

Women with a partner and children face significant obstacles to their mobility in pursuing a career in scientific research (Ackers, 2004; Martinez et al., 2007; Universities UK, 2008). Ackers established that when a couple were faced with an international move, women were more likely to defer to their partners' career interests, whereas men in a similar situation were less likely to do this. These cultural pressures result in a major attrition of women who put their time and effort to studying for a doctorate and developing a scientific research career, thus creating a huge loss to the science profession. Many women academic scientists (49 per cent according to ASSET 2006 survey) are partnered with a male scientist (Athena 2008). At a certain point in their careers, women in these double scientific career couples may need to put their own career development on hold and follow their partner, and they are unlikely to find a position in a university or research institution (reported in Universities UK, 2008; evidence by Ackers 2003, 2004). Often, the woman has to settle for any position that she can find, effectively de-skilling herself and removing a highly skilled scientist from the research labour market (Ackers 2003, 2004).

Masculine cultures of SET disciplines

Women in the SET in faculties continue to be in minority, particularly in engineering and computer science. Much research has been done on the ways in which predominantly masculine environments make it difficult for women researchers to succeed (for instance Bagilhole, 1993; Knights and Richards, 2003; Bagilhole, et al., 2008). A detailed description of the mechanisms by which masculine cultures impact women in academia is beyond this report, but some aspects typical for sciences are discussed below. Other related topics, such as long-hours cultures, are discussed in other sections of this report.

Whitelegg, et al. (2002) reported that many young women physicists felt they had to be part of the masculine culture in order to progress in their work and be part of the team. Several women also commented on the 'lads' culture of 'going down the pub' after work to discuss work/research, but also cars, computers, football, and girls. Furthermore, the male culture was seen as being more confrontational, self-confident and sharing of new ideas and contacts amongst themselves. One female interviewee, for example, said: "...science in Britain is very much an 'old boys' club', it is very apparent and they are not likely to change in the time scale of your career or when you start to have a successful career, then you have to play them at their game rather than trying to go in there and change the system."

Moreover, women researchers in SET often feel that they have to fit in and blend with the prevalent masculine cultures. As expressed by one interviewee in the Whitelegg et al.'s (2002) study: "I think women in a scientific environment really do have to ... be more male in a way. They do have to try not to change the system too much, but try to adapt to the system". Also

female biologists in Garforth and Kerr's (2009) study were more comfortable presenting themselves as gender-neutral researchers rather than drawing further attention to themselves as women.

As reported by the WIRDEM group³, sexist images and metaphors in the culture of science are also a problem; sometimes they are used bluntly, but mostly quite 'innocently', that is, without the sensitivity or competence to assess their discriminatory effects (WIRDEM Report 2008). Women are often reluctant to voice their concerns about such issues in case it singles them out and they are seen as 'feminists' rather than 'one of the lads' (Whitelegg, 2002; Etzkowitz, Kemelgor and Uzzi (2000).

Based on the evidence many researchers point out that more attention has to be paid to the 'invisible' masculinity of career norms, identities, and research cultures to redress the gender imbalance in sciences (for example, Garforth and Kerr, 2009).

Lack of female role models

Women academics are under-represented in SET faculties and on decision-making scientific boards. Only 7.4 per cent of SET professors in the UK are women. If women scientists are not visible and not seen to be succeeding in their careers, they cannot serve as role models to attract and retain young women in scientific professions (WIRDEM Report, 2008).

Whitelegg et al. (2002) reported that several female physics researchers in their study said that it was difficult to tell whether there was a glass ceiling or not because they couldn't see any women in top positions in their professions. One woman put it like that: "Any women I do see at the top, are three times better than any men, they are exceptional, they really are and they are nearly all single without children." In addition, some women in the PhD chemistry study reported that they were turned off academic careers because were worried by a lack of "feminine" role models, especially but not only, at the highest level. This implied to them that it is very hard to be feminine and progress in academia (Lober Newsome, 2008a). In opinion of one participant of this study: "You look at lecturers in chemistry and out of about 30 people, there's two women. From statistics you think, 'It's going be quite hard to be one of those two women'. Plus the women who do succeed are very strong minded, really strong women that have to fight their whole way up and I don't know if I could do that."

³ The aims of the expert group on Women In Research Decision Making (WIRDEM) have been to identify and review positive actions and gender equality measures at institutional and national level to promote women into senior positions in public research. The WIRDEM report has been produced during the 2007 European Year of Equal Opportunities for All, an initiative leading the way to a bolder strategy to establish definitely the fight against discrimination and to promote equality between women and men at EU level.

Less opportunity for networking

Due to persistent stereotypes and associated practices, it is more difficult for women to enter influential lobbies, informal in many cases, which constitute an important element of support for access to decision-making posts (WIRDEM Report, 2008). The impact of networking can also be seen in the pay-gap: although status and salaries can be similar for both sexes, when it comes to extra activities (lectures, being members of boards for PhD theses, advisory committees, etc), it is very often men calling upon their male colleagues (reported in WIRDEM Report, 2008).

Gender pay gap

As already discussed the modest remuneration of post-doctoral researchers is one of the causes of attrition from academic research. Further, there is evidence of a gender pay gap in SET academic disciplines. For instance, Lober Newsome (2008) reports that median hourly pay for biological scientists and biochemists stands at £16.38 for men but only £15.08 for women – an 8 per cent pay gap (data procured from ONS, 2006). The findings of the UEA research staff survey suggest that women research staff start to loose out in salary terms in their mid twenties (Athena, 1999). Anderson and Connolly (2007) report that men academics in SET are not only better paid because they are employed in more senior positions, they are also more likely to earn more within each grade than their female counterparts (including CRS/post-doc grade). The researchers show that seniority, age and experience explain only 77 per cent of the pay differentials between male and female scientists. Despite their qualifications and commitment to career, female scientists experience an ‘unexplained’ pay gap of 23 per cent - over £1,500 pa, which the researchers attribute to discrimination (data collected by the ASSET survey, 2004, discussed in Anderson and Connolly, 2007).

Greater engagement of women in under-valued teaching and administration

Teaching and administration, undertaken by more women than men, are under-valued when it comes to academic assessments and promotions. According to the WIRDEM Report (2008), it is still a common gender stereotype to see women as talented teachers (because of their good communication and soft skills, and ‘an open ear for students’), and to see men in research (because they are hard thinkers, analytical, more objective). The authors of the WIRDEM Report argue that this image is reflected in the gender-biased division of labour in academia with female staff concentrated in the teaching, and the males in research, according to the saying “women teach, men think”. Greater engagement in teaching and administration was suggested as one of the reasons for lower rate of publications by female researchers (WIRDEM Report, 2008) and thus less chances of academic advancement. Women are also more likely to undertake the lower-ranked administration duties. Garforth and Kerr (2007) report that in their study of researchers in biological sciences women were much more likely to have the ‘housekeeping’ roles and unconventional, often unrewarded working histories than their male colleagues (also discussed in Etzkowitz et al. 2000 and in the WIRDEM Report).

Relentless competition among researchers for permanent posts

Strong competition among researchers for academic jobs, possibly because there are many more PhD students and post-docs than there are permanent academic posts, has been reported in a number of studies (Lober Newsome, 2008a; Oliver and Ackers, 2005; Martinez et al. 2007). Lober Newsome reported that female chemistry PhD students in their sample were much more deterred from pursuing an academic career than male participants by the high level of competition for academic jobs. Underlying female participants' fears was a tendency to doubt they had a chance of being successful were they to apply for a lectureship. As one female focus group participant said: "I started thinking about academia but I'm just nowhere near good enough...the competitiveness for a lectureship is just daft and I think I would just be wasting my time". Women also saw their male colleagues as being in with a much better chance of securing a permanent post than they were: "There's obviously a lot of good guys around and you think, 'I'd never make it compared to them'..." "Men are quite often a bit more big-headed. They think they're great. But women are more realistic and think 'no, I'm not that good.'"

The lack of confidence among female PhD students may stem up from the awareness of many challenges that they may have to face if they continue with the academic careers, including the necessity for many women to combine family obligations and a career, covert or even open discrimination experienced during their years of training and early careers, and less favourable professional environment (Martinez, et al., 2007; Whitelegg et al. 2002).

Research perceived as all-consuming, solitary and not sufficiently collaborative

Both female and male participants of the chemistry PhD study by Lober Newsome, (2008a) agreed that staying in academia is a "labour of love" rather than necessarily a sound career move. Both sexes also referred to the requirement to continuously source funding and deal with paperwork as a disadvantage of working in academia. In opinion of the respondents this was not the case in the industrial research. One female graduate said: "There's so much pressure in academia. You've got to do research but you've also got to get funding and do a lot of teaching as well. You have to spread yourself far too thinly. Whereas in industry you've got more of a support network. You don't have to teach anyone what to do or try and raise the funding required to run projects. You can just focus on the research and development."

Mainly female participants, however, identified the disadvantages to academia that it is an all-consuming, solitary career, involving too much competition at the expense of collaboration. For some this was a basis upon which to rule an academic career out, as expressed by a female student: "You have to give up your life to be a scientist. And that's not actually what I want anymore. At one point I would've been quite happy to do it. But actually having lived it I don't actually want that lifestyle anymore. I don't want to have to put in endless hours just to keep a job."

Further, female participants in the chemistry PhD study had a sense that academics exist independently from each other. One focus group participant expressed her opinion on the solitary nature of research as follows: “Nobody seems to get on, nobody seems to talk to each other. There’s no social side to any of the staff”... “In the organic section, I don’t think they talk to each other if they can avoid it...” It puts you off being an academic. It just looks like such a solitary and unsociable job.” Lober Newsome also reported that female participants had a sense that academics are too competitive with each other, at the expense of collaboration. The lack of team-work, reported by some participants, was particularly viewed as a problem among academic research groups.

The findings among PhD chemistry students were supported by Garforth and Kerr (2009) who noted that some of the key discourses of feeling isolated and undervalued came from women post-doctoral researchers. Garforth and Kerr examined two disciplines: biological and social sciences and the findings were very similar, suggesting that isolation and feeling undervalued are problems also existing in the non- SET faculties.

Poor supervision

Oliver and Ackers (2002) note that Principal Investigators (PIs) have an important role to play in terms of the management of the careers of ‘early stage’ researchers. It is the responsibility of the PIs to mentor, supervise and train their researcher staff and PhD students who are dependent on them to provide these forms of support. However, in the PhD chemistry study (Lober Newsome, 2008a) a larger proportion of female than male participants had:

- ◆ Been deeply affected by what might be termed ‘standard supervision issues’ (e.g. enjoying little pastoral care and having to cope with a supervisor who lacks interpersonal/management skills);
- ◆ Encountered significant supervision issues, which they felt powerless to resolve;
- ◆ Experienced a lack of integration with their research group, isolation and exclusion (and more rarely, bullying).

Both PhD students and post-docs (particularly women) often feel powerless to resolve their supervision issues. This is possibly because of a fear of being on poor terms with their supervisor (the influence that supervisors have over their students/post-docs is enormous, including provision of references, recommendations, and invaluable contacts, and help in finding jobs). The findings of the PhD study, for example, showed that some women felt powerless and defeatist about their supervision issues: “It’s well known that the top chemists are really not very nice people and treat their groups horrendously but everyone thinks that’s acceptable and that’s how you become a successful chemist – to be horrible to your subordinates. Nobody ever stands up to them and says, ‘Actually you treated me really badly.’ You’d just be laughed at...” (Alice, PhD completed) (Lober Newsome, 2008a) Evidence from PhD students study finds support in The UEA research staff survey, which showed that 33 per cent of women rated support from their PI below average, compared to only 20 per cent of men (Athena, 1999). It needs to be noted here that we do not know whether the female students and

researchers get poorer treatment, or whether their expectations and their needs are greater than those of male students/researchers. This issue needs to be examined further.

Singer (2004) reports that particularly in the sciences, many PIs view post-docs not as apprentices but as skilled, bargain-rate assistants, who become increasingly valuable with time, and that the relationship between post-docs and their supervisors too often confers a benefit to the mentor at the cost of the post-doc's career goals. Singer also argues that the post-docs' primary responsibilities often become that of carrying out research defined by their supervisor as well as training undergraduate students and new post-docs, with little concern for their development of independent ideas and research. Professor Wendy Hall (2007) thus summarised the situation: "The overriding issue is the attitude of universities toward their research staff, whom they often regard as the 'property' of PIs. This attitude is largely responsible for keeping researchers tied to short-term grants." She argues that the Principal Investigators must learn to let their researchers go, allowing them to develop so that they can go out into the world and conduct their own research, be it in academia or in industry. Researchers need career development, greater job security and recognition.

One of best ways on providing researchers with independence to develop their own careers is provision of independent grants and fellowships.

Research grants and fellowships

Representation and success rate among research grant applicants

Table 1 shows that the female proportion of applicants varied between 11.8 per cent and 18.3 per cent across 4 research councils providing grants in 2007. Women who apply for funding appear to have the same or slightly lower success rate compared to their male counterparts. For example, among all women applicants in 2007, between 18.4 per cent – 31.7 per cent were successful, compared to male success rate of between 27.5 and 31.7 per cent in the same year. The data shows a small increase in the proportion of female applications between 2003 and 2007 for Engineering and Physical Sciences Research Council (EPSRC) and Natural Environment Research Council (NERC).

Table 1. Proportion and success rates of female and male applicants by research councils⁴ in 2003 and 2007

Research Council	2003				2007			
	Female applicants (%)	Success among all women (%)	Male applicants (%)	Success among all men (%)	Female applicants (%)	Success among all women (%)	Male applicants (%)	Success among all men (%)
BBSRC	18.8	27.6	81.2	29.7	18.3	27.6	81.7	29.7
EPSRC	9.6	30.2	90.4	31.6	11.8	31.7	88.2	31.7
NERC	15.3	32.0	84.7	36.0	18.1	18.4	81.9	27.5
PPARC	10.4	65.5	89.6	82.1	n/a	n/a	n/a	n/a

Source: BBSRC EPSRC NERC PPARC, secondary analysis by UKRC

Why are grants and fellowships that are independent of principal investigators' (PIs) funding important to young researchers?

Grants and fellowships enhance status of researchers at the early stages of their careers and may act as stepping stones to a permanent academic post. They are often identified as the primary recruitment pool for established positions (Oliver and Ackers, 2005). Independent grants and fellowships allow young researchers autonomy from principal investigators' (PIs) projects, provide recognition, often difficult to achieve for researchers working on PIs' projects, and, depending on conditions, they may provide a way in for researchers wanting to return to research after career breaks (Oliver and Ackers, 2005). And finally, grants and fellowships also help researchers to establish networks, particularly if they involve conference attendance, and collaboration with other institutions. According to Marie Curie fellows, for example, the most important benefit of the fellowship lay in the access to academic networks. 76 per cent of former Marie Curie fellows said that their fellowship resulted in the development of networks that were influential in shaping their career progression (Oliver and Ackers, 2005). Young women researchers, who often have less developed networks as they are in minority among male colleagues, could find that of particular value.

There is a potential conflict of interest between post-doc researchers and principal investigators (PIs). It has been reported by researchers that although academics can formally share grants (where this is permissible by the sponsor) and PhD student supervision with their research staff, few elect to do so (University of Leeds Report, 2002). This is supported by Oliver and Ackers (2005) who note that personal research fellowships provide a privileged means for researchers to shape their own research interests and career prospects. Working as a post-doc, on the other hand, restricts the ability of a

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BBSRC - 'Biotechnology and Biological Sciences Research Council'

EPSRC - 'Engineering and Physical Sciences Research Council'

NERC - 'Natural Environment Research Council'

PPARC - 'Particle Physics and Astronomy Research Council'

researcher to determine the nature of their work. The fellowships increase researcher autonomy, they argue, and help young researchers to secure contractual continuity by shifting from a post-doc researcher to principal investigator⁵.

In further support of grant and fellowship system, Anderson and Fox (2003) report that first of 8 main listed reasons for unsuccessful applications for first lectureships were commonly claimed to be insufficient research experience, while factors perceived to contribute to successful appointment at lectureship level included in the first two: research which fits with the department and research publications. Autonomous research financed by grants and fellowships contributes to enhanced research experience and independent publications. Unfortunately, Anderson and Fox (2003) also report that career breaks – a break from employment for family reasons in the previous 10 years - seem to have a considerable negative influence on grant application activities. Just over a third of those who reported career breaks (almost all women) had applied for grants. Grant applications were also lower than average among women with dependent children – 50 per cent had applied for grants compared to 62 per cent of men with children.

The difficulties that women researchers with children face are occasionally recognised. Whitelegg, et al. (2002), for example, reports one postdoctoral fellow in their sample applying for a special type of research grant funded by the Royal Society in the UK that enables women to take maternity leave by adding the time taken out onto the fellowship at the end of the contract. It also allows women to switch between full-time and part-time working at any point. This is an example of a structural change that offers alternative ways of working, however there are only 12 of these fellowships for the whole of science (reported in Whitelegg et al., 2002). It should be noted here that there are other fellowships, described in the next sub-section, but they are very few in numbers.

Council for Science and Technology Report (CST, 2007) recommends a change of culture in HEIs in the context of developing a national framework for research careers and a further increase in independent research fellowships for early career researchers. The recent results of Garforth and Kerr's (2009) the UK KNOWING project support these recommendations. The authors agree that opportunities for researchers to join the standard academic career track should be opened as widely as possible, through initiatives such as the increased provision of independent fellowships in relation to project and grant funding.

Schemes to support female researchers and academics

The following UK schemes are specifically designed with the needs of women in mind.

⁵ In order to achieve higher degree of autonomy and experience the researchers in principle could also apply for their own research funding. At the present time, however, the eligibility criteria of major funding bodies restrict the ability of contract research staff to act as principal applicant in research applications, although they may act as co-applicants (Oliver and Ackers, 2005).

The Royal Society Dorothy Hodgkin Fellowships are 4 year awards for early career scientists who can demonstrate the need for flexibility in their working arrangements - for example because of caring responsibilities. The holder is able to convert the fellowship from part-time to full time and back again, and reclaim any time lost through maternity leave or part-time working. The holder can also claim some funds for family support such as the cost of childcare during a conference or collaborative visit abroad. About 10 fellowships are awarded each year in all areas of the life and physical sciences, including engineering, but excluding clinical medicine.

For further details and eligibility requirements see:
<http://royalsociety.org/Dorothy-Hodgkin-Fellowships/>

Please note that it is possible to hold other Royal Society Fellowships, such as the University Research Fellowships, on a part-time basis. Contact the Royal Society for more details.

The Research Councils offer a range of Fellowship programmes from early career to senior appointments. It is possible to apply to hold these on a part-time basis, or to convert to part-time during the period of funding – which will be extended accordingly. For full details contact the relevant Research Council.

The Daphne Jackson Trust offers 2 year part-time fellowships to enable scientists, engineers and IT specialists to return to work after a career break. Applicants must identify a suitable host university or research institute and they must submit a research proposal which is timely and relevant. Alongside their research project, fellows are also required to complete training that will support their research and help update their skills and knowledge to facilitate their return to work.

For further details see www.daphnejackson.org

The For Women in Science Programme sponsored by L’Oreal, UNESCO and The Royal Institution offers a range of awards for women, but of particular interest are the L’Oréal UK and Ireland Fellowships. Four fellowships are awarded annually to outstanding female postdoctoral researchers. Each worth £15,000 (equivalent € for candidates in Ireland), the Fellowships are tenable at any UK or Irish university / research institute to support a 12-month period of postdoctoral research in any area of the life or physical sciences.

The fellowships have been designed to provide practical help for the winners to undertake research in their chosen fields. For example, winners may choose to spend their fellowship on buying scientific equipment, paying for child care costs, or indeed what ever they may need to continue their research.

For information about previous UK and Ireland winners visit www.unesco.org.uk

The UKRC is the UK's lead organisation for the provision of advice, services and policy consultation regarding the under-representation of women in science, engineering, technology and the built environment (SET).

We work with employers; professional bodies; education institutions; women's organisations and networks; policy institutes; sector skills councils; the government and many others to promote gender equality in SET. We offer tailored services and support for women at all career stages.

See <http://www.theukrc.org/> and select Resources and SET Directory.

Overview of barriers faced by women returning to careers in research

Evidence shows that irrespective of women's academic qualifications, societal and cultural pressures often restrict their ability to work in a way that will further their careers (Ackers, 2003, 2004, Universities UK, 2008). Once women have children and take a career break, they usually become dependent upon their male partner's employment, and lose their place in research (Garforth and Kerr, 2009). Their return to research/academic careers is extremely difficult for women as they no longer have the linear unbroken career path that is the backbone of promotion system in the academia (for example Garforth and Kerr, 2009). In such a system career breaks, returning to research careers and 'sideways moves' are very difficult. Biology researchers in Garforth and Kerr's (2009) study reproduced the narrative of an unbroken linear career path as an unquestioned norm, and saw keeping up with a fast-moving research field as a basic prerequisite of the research career.

Non-linear and atypical career paths are on the increase, and there is growing recognition of the positive benefits of researchers applying their research skills in the wider economy. However, there is little research exploring the potential gender issues in the accessibility of support structures for movement into and out of research careers over the career lifetime. Further data and analysis of the support available to researchers moving back to research after working in other sectors or returning from career breaks would be valuable.

The For Women in Science Programme is part of a range of measures within the UK to support career progression, reduce attrition and enable women scientists to make their full contribution to the economy and society. Raising the visibility of women scientists and their achievements is an important aspect of the work of the partners in the programme to overcome the barriers and disincentives highlighted in this report.

The UKRC works in partnership with the Equality Challenge Unit to deliver the SWAN Charter and awards scheme to assist in improving the working environment, culture and structures in university science departments to enable women to advance in higher education and research. UKRC also offers a range of support services for individual women in science, engineering and technology at all career stages. <http://www.theukrc.org/>.

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