Young Women's Perceptions and Experiences of Becoming a Research Physicist

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ABSTRACT

This paper documents detailed accounts of the career experiences of young women physicists in the UK. It identifies some of the barriers and constraints met by these young women during their participation in research careers and examines the notion of 'direct' and 'indirect' gender barriers. It addresses the idea of subtle discrimination by examining both perceived institutional employment practices and the prevalent 'male' culture or atmosphere in physics research, which contribute to the 'leaky pipeline' in women's physics employment in the UK.

This research is based on more extensive interview studies with 27 female physicists who are at an early stage in their careers and are all aged under 30 years and is part of a larger scale project which also surveyed all male and female members of the UK Institute of Physics aged under 30 who held doctorates. The women reported on here have some different perspectives to the more established, older physicists interviewed in earlier work and it is these perspectives that form the focus of this paper.

INTRODUCTION

Our research mirrors several of the findings of Swedish researchers, Sylvia Benckert and Else-Marie Staberg, (1998) (1) and in particular the different perceptions held by younger and older women about gender-related barriers or constraints they have met in pursuit of their physics careers. In our survey of women PhD members of the UK's Institute of Physics (IOP), only 15% of the younger women (aged under 30) said they had encountered gender barriers compared with 45% of older women. However, within a few years of completing their PhD's only 1 in 4 of these young women remain in science employment although they had previously aspired to work in academic or research careers. The reasons given for leaving science include a dislike of the 'male' culture or atmosphere in research careers, the fact that few young women think they will ever attain a senior physics post, concerns about balancing a research career with a young family and because women often give up physics employment to relocate with their partners' career moves. These are clearly gender-related barriers and constraints although these young women often do not perceive them in this way. This interview study provides us with a wealth of data but space does not permit all aspects of the research to be considered here. This paper reports on the continuation of our work that charted the barriers and constraints female physicists encountered during their schooling, higher education and careers (Hodgson, Scanlon and Whitelegg, 2000) (2). This earlier phase of our work was based on in-depth interview studies with six female physicists spanning a range of ages. This paper will concentrate on young female physicists views of the discriminatory practices (subtle and sometimes not so subtle) that they perceived during their doctoral work and early stages of their careers, the cultural factors and atmosphere and that gave rise to some of the research and employment practices within their institutions, and their views on their future careers.

The 'pipeline' approach has been used frequently to provide an analogy to the supply of female scientists. This approach assumes that if enough women are encouraged to enter science and engineering professions then the gender gap in employment will disappear. However, we are now aware that the pipeline contains many hurdles and often these

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hurdles result in a leak from the pipe! So instead of a smooth flow down the pipe, for women the flow is very turbulent with the torrent reducing to a trickle after a very short time on the journey! So the pipeline approach is a necessary but not sufficient condition to overcoming barriers to the participation of women in science (Etzkowitz, Kemelgor and Uzzi, 2000) (3). Not only are their many hurdles to overcome once women scientists are embarked on their careers, but each time a new hurdle is encountered a multiplier effect can seem to increase each new hurdle.

BACKGROUND

The 'leaky pipeline can be demonstrated by the following statistics taken from the UK Government's Department for Trade and Industry (DTI) website 'Promoting SET for Women' (4). At all educational stages in the UK girls now out perform boys in achievement in science up to age 16 (the end of compulsory schooling in the UK). Most pupils (in England, Wales and N.Ireland) take the double award science examination at 16 but a few (often those in selective schools) still take separate sciences and in 2000 for those, boys equalled girls performance in biological sciences, girls outperformed boys in chemistry and computer studies and boys slightly outperformed girls in physics but the gender gap narrowed. In 2000 girls outperformed boys in all science subjects at A level (18+ examination). For physics A-level in England less than a quarter of the candidates (22%) in 2000/2001 were girls, however and a higher proportion of girls pass A (and AS) level in physics than boys and their high success rates have meant that there has been a small increase in the total numbers passing since 1993. (In 2000/2001, 91.5% (6,321) girls passed compared to 85.5% (22,864) of boys).

At university, over the period 1995-2000 the number of women gaining higher education (undergraduate) qualifications in physics and related courses slightly increased with 20% of physics undergraduates in 2000 being female. This was the second lowest figure (with Computing Science) only Engineering and Technology courses being lower. Research councils fund the majority of postgraduate (PhD) students. The research councils that fund PhDs in physics are the Engineering and Physical Science Research Council (EPSRC) and the Particle Physics and Astronomy Research Council (PPARC). In 1995-2000 women increased their share of EPSRC awards for doctoral work to 21% of all awards and in 2000 women were 19% of PPARC supported students. This is against a background of more and increasing proportion of women gaining higher education qualifications (51% to 55% from 1995 to 2000) and gaining more postgraduate qualifications than men from 1998 onwards.)

In 1995 women were just over a third of all Mathematical and Physical Sciences[2] graduates entering full-time employment. However, statistics from an IOP survey of members done in 1998 (Gehring, 2000) (5) indicate that women members of the IOP (who are generally in physics-related careers) only represent 3% of top management (compared with 12% for men); 15% of senior management (35% for men); 50% of junior (37% men); 3% in administration (1% men) and the remainder were new recruits to the Institute (probably students doing their first or higher degrees). A similar picture is seen for women in academic posts with only 2.7% female professors in physics.

So this research is set against a background of women's increasing participation in physics (and chemistry) at all levels, from school to postgraduate studies.

RESEARCH METHODS

For the research reported here, a qualitative methodology was adopted. This was felt to be appropriate for this study in order to uncover the issues and factors that influenced the participants' journey from school to university to PhD to early careers. It was felt that a quantitative approach would mask what had really happened to the young women during their journeys. The participants in this research were all members of the IOP. All 27 should have completed their PhDs, but in fact we found that some were still in the process of completing and a few had abandoned their doctorates altogether. The research focussed on particular areas of these women's' lives: early educational experiences; secondary school experiences; subject choices at 16+; teacher and parent attitudes and expectations; support from teachers and parents; single sex and mixed sex schooling; undergraduate experiences; postgraduate atmosphere; culture in university and at work; influence of senior women; mentoring and support structures; doctoral supervisor's role and attitude; interactions with peers. All the interviews were transcribed and the dialogue analysed using NUD*IST. The outcomes reported here will focus on a proportion of these areas i.e. culture and atmosphere in the laboratory or workplace now and views of future careers.

[2] Physical Science means physics and/or chemistry

RESULTS

Culture and Atmosphere

Several interviewees mentioned the 'lads' culture of 'going down the pub' after work to discuss work/research. Many women felt they had to be part of this culture in order to progress in their work and be part of the team. In addition to talking about work, the conversation would also be about cars, computers, football, girls…. The women reported that their male colleagues felt that it was OK to ask a woman out to the pub or for a meal to discuss work, but the women felt unable to do the same – "it wouldn't look professional". In labs where there were a number of women, they tended to socialise over lunch rather than go to the pub in the evenings. The male culture was seen as being more confrontational, self-confident and sharing of new ideas and contacts amongst themselves. One student 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." Another student said, "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 …." They felt it was important to fit in and if you didn't like the 'office banter' or found some of the conversations sexist, then you should object and this would be respected. Some thought that this 'banter' added to the moral of the work force. There was also the view that women with a physics background are more used to the male atmosphere than those from say, biological sciences who react much more negatively when exposed to it.

The presence of more women in the workplace or laboratory was generally felt to reduce the male atmosphere, however, a contrary view was also given that sometimes it could be a good thing to be in a minority as it increased visibility and this may be to women's benefit. However, if there were only one or two women and they weren't excellent teachers or supervisors, or they weren't interested in encouraging other women to follow a similar career path, this minority had a disproportionally negative effect. Good role models were felt to be women who managed to combine their working and family lives efficiently and were felt by the interviewees to be more effective during the time they spent in the lab than some men who worked very long hours. The young researchers also felt that who women had interests outside the lab were likely to offer more diverse solutions to problems than some men who were viewed in a stereotypical way - only thinking about science to the exclusion of everything else.

During their PhD research, women mentioned that the allocation of projects was not always influenced by appropriate factors - perceived physical strength was sometimes given as a reason for allocating particular projects to males and in other instances men were given projects before women because they persisted in asking for them. Women and men are also treated differently when things didn't work out in the lab. One student said that this different treatment was even put in writing, "we were given bits of paper when we started our PhD on how to cope with equipment failure, it was actually written down, 'bursting into tears or just ditching it in favour of the pub is not reviewed very kindly by your supervisor.'"

Direct harassment was fairly rare. One woman said: "Although I have never experienced any blatant verbal or physical harassment during my education, I believe a more constant form of psychological harassment occurs, and that is because you are a female in a male dominated field. The psychological harassment is born out of the fact that as a female you are constantly discussed by male colleagues behind your back, and you are never sure if a male colleague has helped you because of ulterior motives. This makes trusting male colleagues hard or forming normal friendships difficult."

In this category, some women mentioned technicians' attitudes and the culture in the technicians' rooms (e.g. displaying 'girlie' calendars, and even bottom pinching!), and difficulties with men from countries outside the UK who had more stereotypical views of women. One woman said "Sometimes its necessary and I don't like doing it, but sometimes its necessary to flirt a bit and do the whole poor female thing in order to get a job done and its gone to the point where actually some of my male colleagues, people I work with in the lab, send me to go and do things, because they think I will get it done faster and get a faster response from the technicians (than) if they do it so if there's a collective thing that needs doing, I get sent. I am not going to be able to change it, so I might as well just play it at their rules, its not an ideal situation, but I think you learn to live with it."

Older males (aged over 55) were sometimes perceived as having stereotyped attitudes to younger women postgraduates and employees. These were seen as a barrier to career progression. Of those women who had experienced direct harassment, they saw the harassers as older men who were trying to

hang onto their youth! In these situations the presence of other female postgraduates and female staff was beneficial for mutual support. One researcher thought that people saw women who go into physics as physiologically different from others. She said: "I think there are quite a few people here who think that men's and women's brain are different and that the women who go into physics are like the sort of 5% of the [population] with peculiar brains, … so its like we are honorary men basically."

Nearly all the women postgraduates had male supervisors (PhD advisers). Many felt that they were treated a bit more carefully because they were female, perhaps they were not shouted at as much as the boys! Most felt that their supervisors were supportive, and many, but not all, were given support in conference attendance and when applying for jobs. However, the women often accepted this support as a privilege, rather than as a right. One student even felt that she had been lucky because she was invited to talk at a couple of conferences, rather than seeing these invitations as her just reward for outstanding work. Another woman suggested that prizes weren't always awarded on merit. She said:" I really think that to be a woman you have to be three times as good as a man to be considered his equal. For example I did work really long hours when I was there, I didn't get a lot of support from the people at … and both Jane and I worked really hard and we both got papers published, whereas our male colleague, didn't get a paper - well he only got conference papers published, yet he was awarded the best student of the year, really obvious examples like that. His research was slightly more trendy or more flavour of the month, but nevertheless the attitude was always down to the best student, even though we had papers published and he hadn't, which I though how are you judging it, what criteria are you using?"

Views of their future careers

When asked to forecast how their careers might develop in future, most of the young women interviewed raised issues concerned with the difficulties of combining working with raising a family. Most did aim to have children but many predicted difficulties both in taking maternity leave in the first place and later on in combining childcare with a lab-based research career.

Their perception was that it was very difficult to take maternity leave whilst being funded by either a PhD students' grant or by a research fellowship for a postdoctoral project. PhD study in the UK is normally funded for 3 or 4 consecutive years. If a doctoral student takes time out to have a child, her university department may also suffer because the record of completion of the PhD will be longer than the target of 3-4 years. (Instances of non-completion within the specified timescale can result in the external funding councils refusing to give grants to research students in a particular university department.) If time is taken from a research fellowship at postdoctoral level then the grant may expire before the project is completed. In addition, because research is assessed by the number of research papers published, the production of fewer papers will damage a researcher's record. One researcher said: "My problem is that the way it's judged how good you are doing is how many publications you have got. If in a two or three year post you decide to have a baby and took a year out for maternity, then basically a third of your contract has disappeared, a third of your publications have disappeared. Therefore you are a third as less likely to get another position because it's based on your work in the previous position."

Post doctoral positions funded by short term research grants are the norm for several years after completion of the PhD and these years coincide with the optimum childbearing years for women. Several women interviewed said that they would delay having children until their thirties when they hoped to have permanent positions but they feared that there may be discrimination against women with children for these positions. Young women still studying for their PhDs also noted the experience of older women in their labs. They talked about the problems when female PhD supervisors went on maternity leave, particularly if they took a year out, and the difficulties this created for the supervisor's students who was left without adequate supervision during this time. Whilst it is the University's responsibility to make provision for supervision, the effect may be to make a supervisor feel guilty about leaving her student if nobody else has her particular expertise to supervise in her place.

In addition to the problems of funding, paper writing or responsibility for others, the 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. One researcher said: "You can't really progress beyond my level now unless you are willing to do all sorts of travel, all sorts of night functions entertaining customers, etc. and it just doesn't fit in with home life." They felt that the work was very inflexible and were not aware of part-time opportunities in 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 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.

One postdoctoral fellow was applying for a special type of research grant funded by the Royal Society in the UK. This grant recognises the difficulties that women researchers face and 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.

The researchers held mixed views about existence of a 'glass ceiling' – some of the younger women felt it was a thing of the past and would not affect them. Some felt it existed more in careers in industry than in academia and others felt that it was more in evidence in physics/engineering professions than in careers in the financial sector. Several women 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. "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." Indirect evidence of the existence of a glass ceiling was mentioned by one researcher whose female boss (aged 45) felt that it was affecting her career progression.

However, researchers predicted progression in their careers and in 20 years time several expected to be working at a senior level. However, for those with plans in academia, many did not want to emulate their Head of Department because of the emphasis on fundraising and the long hour's culture. Participants wanted a career that enabled a life outside work and the opportunity to have a family. They wanted careers that were interesting and "improved things". They would rather "work here, earn less, than be a big cog in a small place" and were concerned that they "can't do all the hours and things and have a nice house and a couple of children and all the rest of it". The women were certainly not without ambition, one woman wished to be "(h)igh up in a scientific company, like managing their technical side or something or running my own company, I definitely wouldn't like to be working in a lab in 20 years time, so something high flying." But many put job satisfaction and conditions before status and salary. "I don't think women achieve in those terms, as measured by position or financial gain, I think it's to do with satisfactions … personal satisfaction and happiness."

DISCUSSION

The statistics presented earlier show that girls' achievements in physics up to undergraduate levels are steadily improving at these stages of the educational pipeline, indeed they have made some remarkable surges in the last decade in the UK. However, although there have been improvements, the numbers of women at the higher levels is much smaller that would be expected according to the pipeline model. The situation at postgraduate level and in the early stages of their careers does not seem so positive.

Our research documents a variety of barriers, constraints, hurdles and thresholds – only a few are reported on here. Those reported in this paper are concerned with young women's perceptions of the culture and atmosphere of the workplace or laboratory and their views on their future careers. Women do not come to postgraduate study with a blank sheet, the few that make it have already jumped many hurdles and have had to overcome their own socialisation as females. Established staff can help or hinder the effects of this socialisation according to their own awareness and willingness to go beyond the status quo. In common with other research in the US (in Etzkowitz, Kemelgor and Uzzi (2000)), several women in our study indicated that they had never spoken to anyone about these issues and concerns before. When they were undergraduates, the women in our study reported much less concern and awareness of a male culture or atmosphere and before they attain established positions, the women are reluctant to 'rock the boat' by voicing their concerns in case it singles them out and they are seen as 'feminists' rather than 'one of the lads'.

Although the 'pipeline model' aims to increase the numbers of women in SET careers it is too simple a solution. If the numbers do increase there is a danger of greater resistance to change. As mentioned in Etzkowitz, Kemelgor and Uzzi's study "the larger the minority the greater the discrimination against it, causing the culture and experience in different departments to seem impervious to incremental change". (2000, p.110.)

CONCLUSION

The areas reported above relate to a small section of the data collected as space does not allow for an exploration of the other areas of women's' journeys down the pipeline. However, within those areas it is representative.

The pipeline hypothesis ignores organised resistance to change and the persistence of barriers to entry and progression of women in science and engineering professions. Until departmental heads recognise the effects of the particular barriers and constraints to women's progression in their careers in physics progress is unlikely to be realised. The pipeline will continue to leak and never deliver more than a trickle of female professional physicists. This pipeline model needs to be supplemented by a focus on changing institutional structures that enable women to develop their careers in ways that suit modern lifestyles and family structures.

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