ABSTRACT

This paper draws its evidence from the report Meta-analysis of gender and science research: Country group report UK and Ireland countries (Bennett et al 2010) which used the Gender and Science Database (GSD, www.genderandscience.org) to compile an extensive literature review of the research already undertaken on women’s and men’s careers in science. The paper begins by outlining the nature of horizontal and vertical segregation in the Science Engineering and Technology (SET) sectors in the UK. It then describes Sue Berryman’s model of a ‘pipeline’ to explain women’s career progression in science occupations and academic disciplines (Berryman 1983). The model has provided a focus for different explanations of the barriers and issues faced by women, combining research on gendered stereotypes and labour market practices and processes. The policy responses which the model has prompted are outlined. The final section of the paper discusses the ways in which the model has been expanded through critique and the development of new research areas, such as in the fields of diversity, globalisation and multiple gendered subjectivities which offer promising ways of moving beyond a view of women’s careers in science as single, narrowing and prescribed trajectories.

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Horizontal and Vertical Segregation in SET in the UK

Horizontal and vertical segregation in Science Engineering and Technology (SET) sectors reflect the main trends in women’s labour market engagement in the UK as a whole. The effects of segregation may be felt long after the industrial landscape which established them, has declined and changed. Important precedents were set for women’s involvement in skilled trades and manufacturing processes during the Second World War which were given up in the peace which followed; an advantage which has not been regained. Men’s greater access to education and the ethos of the male breadwinner half a century ago in the UK are still fashioning men an advantage in the senior ranks of science today. Other factors relating to occupational and workplace cultures also come into play to uphold this privileged position, factors which make it hard for women with caring commitments to successfully compete for promotion.

Horizontal segregation is most concerned with the entry points into scientific occupations: in particular young people’s choice of subjects to study at school, and the decline of female pupils progressing through higher education qualifications in science, despite their greater number and achievement in certain science disciplines at school. The research evidence suggests that girls and boys engagement with science education begins to change and decline as they enter secondary school (Arnot 2000, Bentley and Drobinski 1995). This waning interest, for many pupils coincides with a lack of interest in school rather than arising from a rejection of science. At age 16, selection of science qualifications is mandatory in many schools for pupils of sufficient ability, however this is not the case at age 18. This results in low numbers of entrants for science subjects at ‘A’ Level. Although girls achieved higher grades in these qualifications than their male counterparts despite entering them in smaller numbers, these statistics indicate the beginning of the narrowing of the career ‘pipeline’. The UK Resource Centre’s analysis of ‘A’ Level entrants for 2009 shows that girls were over 50% of entrants in Biology and had almost reached equivalence in Chemistry (48.4% of entrants) – anecdotally driven by university medical school entry requirements. However in Mathematics, Technology and ICT girls remain around 40%. In Physics they are just over 20% of entrants and computing only 10%. The 2009 results confirm the trend of girls performing well in the qualifications they attempt. Despite entering in far lower numbers girls performed better then boys in Physics by 2 percentage points and in computing by 2.6 percentage points (obtaining grades A-E). The percentages of girls obtaining undergraduate degrees and post graduate qualifications in STEM subjects 2006/2007 shows considerable consistency. As with young men, the total number of female students continuing on to postgraduate level approximately halves. The gender differences between pupils pursuing a vocation qualification route leading to employment in SET trades are even more pronounced. There are only figures for England: Of 16-17 year olds who left full time education and entered employment in 2003, 43% of young men but only 4% of young women entered skilled trades in SET (GELLM 2006). Take-up of apprenticeships in England 2006/07 illustrated

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2 SET Science Engineering and Technology or STEM Science Technology Engineering and Mathematics are the commonly used abbreviations for the sciences in the UK and Ireland. The full range of subjects which these abbreviations refer to are listed in Appendix 1, they include subjects allied to medicine, and architecture, building and planning.
very clearly the gendered choices and contexts in which young people are operating; 97.6% of engineering and 98.7% of construction places were taken by young men (UKRC cited by Bennett et al 2010:47).

Research into vertical segregation focuses on the pace of women’s progress through academia and private science companies. By breaking down occupational categories by age, it is possible to reveal a two stage drop in the percentage of women working in science: first at the point of family formation (approximate age 25-44) and second when the demands on women to provide care for older family members intensifies (from age 45 onwards). This has given rise to interesting patterns of segregation within the SET disciplines themselves, as women have sought out specialisms and occupations offering the greatest flexibility in terms of hours and work-loading. More women work in associate professional occupations than professional occupations. Overall the female workforce in science is very small; for example, just 8% of engineering professionals of working age are women compared with 48% in the UK workforce as a whole (Bennett et al 2010:48).

**PIPELINE MODEL**

Sue Berryman’s report *Who will do science? Minority and Female attainment of science and mathematics degrees: Trends and Causes* (1983) has made an important contribution to the theoretical and political debates in the UK about women’s representation in science occupations. Berryman introduced the ‘pipeline model’, based on an empirical analysis of gender differences across the entire trajectory of training and employment rather than on discrete educational and career stages. By conceptualising the scientific career as the sections of a narrowing pipeline, this model concisely and visually describes where leakages of female scientists leaving the pipeline occur and the volume decreases leading to shortages in female supply. It prompts questions about the quantity of women travelling down the pipeline (horizontal segregation) and the slow speed of their progress along it (vertical segregation), neatly capturing the political concerns about women’s entry rates and the emerging focus on their progression. It prompted an analysis of where the points of greatest ‘leakage’ were, supporting the arguments that the point at which women were exiting scientific careers coincided with their greater family responsibilities (Rees 2001). In doing so the model has acted as a means to focus policy intervention on certain stages of education and on organisational practices. It has also provided a concise way to unite different theoretical concerns, incorporating literature on the influence of sex-based stereotypes on education and labour market choices, and theories of women’s labour market activity and experience. These theories in turn have reinforced the versatility of the description suggested by the pipeline model.

**WOMEN’S ENTRY INTO THE PIPELINE**

The design of the model as stages of qualification and seniority has prompted questions about the selection of a scientific route of study and the decreasing numbers of women entering each phase despite their comparable and, in many cases, better attainment than their male counterparts. In the 1980s as the model became
more widely used, explanations of why comparatively fewer women entered the pipeline centred on the ubiquitous nature of gendered stereotypes expressing an association between science and ‘essential’ male characteristics: for example the association of masculinity with rationality / technology and femininity with emotion / nature. These binary dualisms were shown to underpin the acquisition of skills in the family from a young age, influencing girls’ and boys’ understanding of desirable gender characteristics and shaping their future interests (Lynn 1966, Garratt 1986, Schwartz 1996). This involuntary process of ‘gender socialisation’ has prompted a large number of studies into pupils’ ‘traditional’ and ‘non-traditional’ educational choices.

Researchers questioned young people about their choice of subjects at age 14 and discovered that whilst boys’ and girls’ perceptions and approaches to science are similar, a significant difference lies in the match between their leisure pursuits and some aspects of practical science. This is particularly true of computing science where more boys admit to spending more time playing computer games than girls (Durndell 1997, Cantwell and Wilson 2002). Johnson (1987) suggests that this confers advantage as traditional boys’ leisure activities equip them with relevant skills which are useful in scientific practical work and give them an experiential base on which to build an understanding of mathematical concepts. Solomon (1997) highlights the ‘comfort value’ which boys develop with technical concepts because of their greater exposure to them. This engagement with the subject matter also gives boys a means of affirming their identity with peers since it a common part of their shared leisure pursuits. Murphy and Whitelegg (2006) found that girls tended to be more fearful about the difficulty of the science subjects which the authors explained was due to the underlying gendered dualism. Walkerdine (1990) suggested that these fears can be further reinforced by the tendency of teachers to associate girls’ achievements with hard work rather than ‘natural’ ability. Bell’s (2001) work on young people’s choice of Biology and Physics qualifications in school concluded that gendered interests underpin girls’ preferences for subjects with a social dimension. Lightbody et al (1997) have argued that young women are more attracted to courses which lead to careers with higher levels of social involvement rather than repelled by courses with technological aspects; Medicine being one such example, Biology another. Woodward’s and Woodward’s (1989) examination of the primary school curriculum (age 7-11) discovered that girls’ interests had already narrowed towards sciences with a social dimension. Similarly Taber (1991) found that on starting secondary schools girls showed a strong preference for Biology and boys for topics with a mechanical connection. Teachers’ reception of this message appears to be mixed; Hughes found that socio-science as a part of curriculum development has been devalued through comparison with the higher status of abstract ‘masculine’ science: Teachers fear that its inclusion not only devalues the overall content of the curriculum alienating ‘traditional’ science students, but also jeopardises their own status as gatekeepers of scientific knowledge (Hughes 2000). Others disagree, Beraud found support for interdisciplinary routes which incorporate socio-economic content to attract women to engineering degrees (Beraud 2003).

A number of scholars have taken the explanation of the association of masculinity with science beyond gender socialisation, claiming that it is rooted in physiological
differences between the sexes. Billinton’s (2007) assessment of cognitive styles found that the choice of physical science subjects was linked to pupils with stronger synthesising drives than empathizing drives and that sex became significant because more boys had this drive than girls. Hacker put it another way, that young men exhibit ‘strong barriers to communicating emotion’ and a predisposed fascination in how things work (Hacker 1981). However the evidence for biological essentialism is contested. For example, Head and Ramsden (1990) used a popular personality inventory\(^3\) to identify a common psychological type in girls who chose to study Physics. The majority of girls choosing science in their study were in the ‘Sensing Judging Quadrant’, meaning that they were realistic decision-makers who focused on the facts of immediate experience, seeking an ordered environment. The researchers found that it was possible to interest girls with other personality types through appropriate teaching interventions in schools, demonstrating that personality and subject choice were not necessarily immutable.

Practical responses to the identification of ‘barriers’ created by gendered socialisation / physiology to women’s entry into the science pipeline have focused on teaching methods and the science classroom environment. There have been a growing number of researchers in the field of Education arguing that ‘girl friendly’ science teaching can overcome restrictive perceptions of normalised roles and behaviour. Gender-aware teaching and single sex teaching have both been identified as approaches that are effective in changing pupils’ attitudes (Shuttleworth 1997). Sullivan’s (2008) measurement of ‘academic self concept’ showed that girls scored higher in Maths and science when taught in single sex groupings. Bentley and Drobski (1995) found that tailored teaching using a problem solving approach (CREST Creativity in Science and Technology) changed girl’s attitudes positively towards science. Research in the fields of Accountancy and Maths at under-graduate level demonstrated that students’ approaches to learning, and the ability of the institution to match them, made more difference to their academic performance than either their gendered identity or sex (Paver and Gammie 2005, Kelly 1999).

The importance of role models and gender-aware careers advice has also been highlighted as a way of convincing more young women to choose science qualifications at school and beyond. Bleekinsop et all (2006) showed that schools which provided mechanisms for supporting pupils aged 14-16 in their decision-making - such as one-to-one discussion with teachers and career advisors - were able to increase their influence making pupils less reliant on family and friends, with implications for pupils’ gendered choice of science subjects (see also Roger and Duffield 2000). Women scientists in Devine’s study confirmed that specialist teachers in their single sex-schools had been an important source of support in the face of considerable opposition to their choice of ‘non traditional’ careers from careers’ teachers and the general teaching staff (Devine 1993). Similarly Murphy’s and Whitelegg’s (2006) extensive literature review of national and international research about girls’ participation in Physics (177 sources) concluded that gendered stereotypes of ‘who does Physics’, influence girls' engagement with the subject,

\(^3\) Myers-Briggs Types indicator is a personality inventory based on the theory of psychological types described by C. G. Jung. It describes four bipolar parameters; Extraversion – Introversion, Judging – Perceiving, Sensing – Intuition, Thinking – Feeling.
their sense of self-efficacy in relation to it, and their perception of its personal relevance. More girls than boys fail to see their future self engaged in Physics and Physics-related careers. They concluded that the way in which Physics is taught can foster a greater sense of ‘belonging’ for some girls.

In contrast to the consensus in the literature that teaching makes a difference, there is a lack of agreement about the strength and importance of parental influence on young people’s choice of science qualifications. For example, Kelly’s et al (1982) study of parents of children in their first year at secondary school found that the majority held egalitarian attitudes towards girls’ choice of science subjects and careers with little variation by socio-economic class. However these attitudes coexisted with traditional assumptions about male breadwinners, and women’s caring roles. Also parents’ own division of domestic labour and their expectation of their children’s contribution to home life was strongly sex-stereotyped. Kelly concluded that children receive contradictory gender messages, which are not as uniformly traditional as interested observers assume. More recent research in the US has identified the importance of fathers’ attitudes in their daughter’s mathematical and scientific achievements. The study found that parents inadvertently spend more time developing these interests in their sons. In families where fathers hold non-traditional views and actively encourage their daughters, daughters themselves and their graded results attest to a significant positive impact (Jacobs et al 2007).

Literature on the influence of peers has been directed primarily to young people’s post-16 or higher education selection rather than to particular subject choices. A small number of studies contain tantalising insights into the pressures which pupils feel to conform to their peer’s expectations and perceptions of science. It appears that boys maybe more susceptible to this type of influence, though the conclusions are tentative and the effect of race, ethnicity and class background have not been sufficiently explored (for example Foskett et al 2003, Breakwell and Beardsell 1992).

Other studies place their onus on the importance of challenging gendered imagery of ‘the scientist’ which affects young people’s choices in surreptitious and subtle ways. Phipps’ (2002) examination of ‘cultural’ stereotyping, puts forward a strong case for positive images of female engineers to redress the balance in the context of gender blind industry public relations. Unintentional stereotyping can be present in a multitude of environments; Machin’s study of a natural history museum found an andocentric bias in both the physical displays and supporting text reflecting both historical and current views of gender within the museum and beyond (Machin 2007). Mendick’s work on films demonstrates a strong association of masculinity with heroic representations of mathematicians which she argues are ubiquitous in popular film and television (Mendick et al 2008).

Interest in the identification of subliminal gendered stereotypes, familiarised in everyday discourses and images has grown alongside the preoccupation in sociological research with post structural analysis in 2000s. One such study by Cornelussen (2005) adeptly illustrates the way in which a hegemonic discourse associating working with computers with male pleasure, positions women in the field as ‘the other’ to such a extent that they report great surprise at ‘discovering’ their own enjoyment of programming. They have then experienced the exclusive
status conferred on this male pursuit and borrowed the discourse knowingly to impress others. Mendick (2005) and Wilson (2003) have demonstrated men’s unquestioned acceptance of and benefits from these types of discourses.

Contemporary research has begun to get to grips with much more complex processes of ‘identity work’ undertaken by young women and men, who formulate and project their identity against a back-drop of many gendered discourses. For example, among pupils questioned about ‘being good at Maths’ Mendick (2005) discovered that their replies were mediated by a series of gendered binary opposites such as competitive/collaborative, active/passive, naturally able/ hardworking as well as reason/emotion. Stepulevage (2001) presented evidence of girls ‘constructed incompetence’ in secondary school Computing and Technology classrooms which they adopted in order to fit with gendered expectations of their peer group. Similarly in their study of medical students, Clack’s and Head’s empirical investigation of perceived attributes found that these were split between women and men along gendered lines: men felt better equipped with ‘a spirit of curiosity’ and ‘leadership potential’ compared with women who reported that they felt more confident in their ‘ability to listen’, ‘work in a team’ and to ‘inspire confidence in others’ (Clack and Head 1999).

Hughes (2001) deconstructed the discourses expressed by students and teachers participating in Physics and Biological Science curricula in a UK city school and post-16 college. Her analysis led her to warn against adopting simplistic explanations based on essential sex stereotypes to account for differences in pupils’ engagement in science education: not all young women are put off by symbolically ‘masculine’ scientific disciplines and equally not all men are attracted to them. She contends that pupils’ subjectivities can be influenced by their ethnicity and class as well as their gender. Nor are they fixed; pupils actively negotiate their identity position/ subjectivity throughout a period of study. Her observations turn the focus onto the content of science curricula, and the need for a fundamental reconfiguration to widen the range of identity positions /scientist subjectivities on offer. They also suggest that there are further reasons for the physical sciences being dominated by a largely male elite, which other researchers have elaborated in their study of science workplaces and organisational relationships.

WOMEN’S PROGRESSION ALONG THE PIPELINE

The division of the pipeline model into discrete sections of attainment foregrounds an analysis of women’s transition from education to employment in science; their choice of career pathway or scientific specialism; and the pace and difficulty of advancing to more senior levels securing higher pay, budgets/funding and reputation. In this way, the model accommodates two broad strands of enquiry, the first exploring individual women’s choices, aiming to explain why so many give up on career progression or have ‘leaked’ from the pipeline. The second places these stalled careers and premature departures in the context of science organisations, examining the performance, expectations and gendered relations which make up the science hierarchy and women’s experience of negotiating their path forward. The first places central importance on the pull of motherhood and the second on the push
of andro-centric organisational practices. The gendered stereotypes and subjectivities which they give rise to, are still prevalent and significant at these subsequent stages of the pipeline.

A key explanation of why women give up on science careers before fulfilling their early potential is that when they become mothers, their domestic and family responsibilities assume greater importance. Examining labour market segregation as a whole, Catherine Hakim (1996) put forward the influential ‘Preference Theory’ which claims that it is women’s own choices about their employment and lifestyles which is the source of their under-achievement in their careers and accounts for most of the differences in women’s and men’s economic outcomes. The theory proposes that groups of women give paid employment different priority and categorises them into distinct groups: ‘work-centred women’ for whom employment is their main priority; ‘adaptive women’ who wish to combine work and family and so are not career orientated or who have un-planned careers; and ‘home-centred women’ who make family their central and only preoccupation. In science occupations research evidence suggests that women pursue the complete spectrum of ‘preferences’ (Dainty et al 2000, Deem 2003, EOC 2004, Evetts 1994, Gammie and Gammie 1997, Henwood 1998, Morley 2007, Raddon 2006, Roberts and Ayre 2002). One of the critiques of Hakim’s theory has been its assumption that women’s working lives are fixed on only one type of trajectory, whereas in practice women can follow different orientations to work at different stages in their lives.

Findings that women who reach the top of the science professions are often childless, and that the majority of women with children who return to SET careers work part-time (Glover 2001) appear to be explained by this argument that this is their preferred choice, guided by essential gender roles. There is a body of research, most notably in the fields of Dentistry and Medicine, which provide empirical evidence supporting this proposition that women choose to halt their progress or even exit from a career trajectory to care for a family (Newton and Thorogood 2000, McEwen and Seward 1989, Shaw 1980, French et al 2006, Wakeford and Warren 1989, Williams and Cantillon 2001, Goldacre et al 2002, Lambert et al 1996, Ward 1982). One of the startling findings presented by this literature is how early on in their careers women are anticipating family formation. Field and Lennox (1996) found that many first and fifth year female medical students had based their choice of clinical attachments on the posts which would best accommodate their desire to have children in the future. An outcome of women’s attempts to remain in the pipeline, maintaining their work orientation with a family is the ‘feminisation’ of certain professional science specialisms. These areas offer greatest opportunity to choose the hours or work and control the workload undertaken, both important factors when put alongside the demands of family dependents. These ‘female enclaves’ (Burchell 1996) include General Practice in Medicine, Pharmacy and public sector science professions, such as Town Planning (a sector which has traditionally offered better family friendly terms of employment). Women’s attempts to secure a ‘work-life-balance’ in which neither work and career or family suffer can be more subtle still. Evetts (1994) found that female engineers steered their career paths away from people management roles to technical specialist careers, in order to manage the hours through accepting a more predictable set of work demands. Caven (2006a, 2006b) has shown that in architecture women who have been forced to work
independently in order to combine non-work activities better with work, report that it has been beneficial to their professional development as well as their work-life-balance.

The accommodation of work and life comes with penalties. Whilst some women plan ahead and select what appear to be more family friendly career paths, others find themselves ‘sidelined’ into enclaves not of their choosing, sometimes referred to as the ‘mummy track’. In Accountancy, Gammie and Gammie (1997) found that women had been deflected to a ‘branch’ of the pipeline, unable to successfully negotiate workplace cultures and long hours which encroach on non-work activities. They were clustered in peripheral jobs within the skilled mainstream or left behind in the more routine, back office or administrative functions of the profession as their male counterparts congregated in prominent or profitable areas of work, commanding higher remuneration4. Rees (2001) and Glover (2000) found evidence of an ‘old boy network’ directing the allocation of jobs and positions of influence, from which women are excluded. The power of these networks became apparent at particular points in the career ladder. Booth et al (2003) proposed the model of a ‘sticky floor’ where women find themselves just as likely to be promoted as men but on achieving a more senior position secure a lower starting salary than their male counterpart5. Other explanations for pay differentials appearing between male and female contemporaries blame women’s lack of mobility, due to family ties: Ward (2000) found that promotion to Senior Lecturer grade is a relatively high hurdle for women, and the ability to move between institutions contributes to men’s advantage in this rank/pay attainment.

A focus on the rewards bestowed by work hierarchies falls within a larger investigation of organisational practices, policies and the unwritten rules of behaviour which fashion the workplace environment for the individuals who participate in it on a daily basis. Developments in feminist theory coinciding with the advent of equality and employment legislation in 1990s produced explanations for women’s absence from the pipeline which centred on science organisations themselves. This second set of explanations may also be linked to the movement of many feminist activists and practitioners from industry into universities, who fostered the academic debate on women’s position in industry. Their research explores in detail women’s experiences at local level and uses this empirical data to challenge the ‘essential’ nature of women’s preferences. Through an analysis of patriarchy they reveal male privilege in the science workplace (Cockburn 1983) and

\[4\] Research about the gender pay gap in science occupations is scant. Evetts found that female engineers tend to be concentrated in lower status positions compared with their male counterparts (Evetts 1993, 1998). They receive lower pay and benefit packages (EOC 2004, Roberts and Ayre 2002, Martin 2001). McNabb and Wass (1997) tracked the progression of full time academics in all disciplines over a thirty year period and concluded that a significant part of the pay differential between women and men is due to women’s under-representation in senior ranks. However once factors such as this are controlled for there remains an unexplained ‘gender effect’.

\[5\] Positions in UK Universities are graded, each grade consisting of a series of incremental salary bands. Movement through salary bands is automatic, subject to satisfactory performance, until the highest band in the grade is reached. An individual must then formally apply and be assessed to be promoted to the next grade in order to increase their salary further. Research shows that women are more likely than men to be assigned to a lower salary band following promotion. They are then faced with having to ‘catch-up’.

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demonstrate the cultural and tangible constraints placed on women’s progression opportunities. There are a number of concepts developed in organisational theory which contribute to explain why the numbers of women moving along the pipeline as it narrows decrease disproportionately. The first, the ‘glass ceiling’ is a phenomenon where women aspiring to more senior positions within an occupational hierarchy find their way blocked by invisible promotion criteria bolstered by male networks. In male dominated science organisations men’s adept use of ‘social capital’ built up through informal relationships and grooming gives them greater access to new ideas and professional partnerships (Etzkowitz et al 2000). Insider knowledge of the informal rules is vital for progression and self promotion. Yet women are excluded from participation because the network is built around male homo-sociability, or outside-work contact in evening hours which clash with home life (Griffiths et al 2007, Jensen et al 2005, Fletcher et al 2007). Cockburn’s work has been hugely influential in demonstrating how men in manual trades have accomplished a separation and elevation of the status of their work from that of women’s work by associating it with technology, and modelling tasks and workloads on male physiology (Cockburn 1985). Bagilhole has been a central author on harassment in the workplace, conceptualising the different degrees of intimidation enacted by men in male dominated environments and its effect on professional women, particularly in the higher education sector (Bagilhole and Woodward 1995). These male strategies throw an ‘iron cage’ around women causing them to self-regulate or impose limits on their own progression. Female SET academics may even internalise or collude with a stereotype of women’s intellectual inferiority; refusing to consider promotion due to lack of confidence, or maintaining a low opinion of their performance to uphold the status quo and not to appear threatening to male colleagues (Bagilhole 2002). Women who attain a senior post, in spite of the obstacles, often become the organisations’ ‘token women’ used as proof that the organisation is tackling gender inequality, a fact that in itself puts many women off trying (Phipps 2002, Rodd and Bartholomew 2006).

The role of gendered stereotypes and subjectivities in the maintenance of organisational cultures was highlighted by Kanter’s ground breaking contribution detailing women’s sex-role performances’ at work (Kanter 1977). Research into organisational dynamics argues that far from leaving domestic identities and hence gender roles behind at home, these roles permeate women’s experience in science occupations. For example in Engineering, Green, Ackers and Black (2002) examined the outcomes of restructuring practices in two manufacturing firms and found that the association of certain types of work with women or with men were deeply embedded on the shop-floor and drew on notions of physical abilities such as ‘women’s nimble fingers’. Many women actively opposed a move to mixed team working, because they preferred an exclusively female space and the female sociability which could take place there; which represented an important strategy for coping with the monotony of factory work. Finally the tradition of family recruitment, stretching back to practices of patriarchal capitalism meant that domestic relationships were never absent in a workplace where parents and their adult children worked alongside each other. Bagilhole’s study of women’s strategies for fitting into the male dominated hierarchy of Engineering academia also relied on ingrained notions of the sexual division of labour, women reported that they faced
less resistance from men and achieved more if they were prepared to adopt familiar family roles, such as the office ‘mother’ (Bagilhole 2002).

Also interested in female coping strategies, Evetts (1998) found professional female Engineers adopting different types of identities to survive in competitive and conflictual nature of male culture they worked in. These were; ‘fronting it out’ (confronting sexism); ‘playing the little women’ (tolerating sexism, employing gendered techniques such as crying); and ‘displaying technical competence’ (building an unassailable reputation). Watts (2007) put it another way, suggesting that women working in the Construction professions become complicit, giving up an overtly feminine identity. In an allied industry Faulkner (2005) made a similar observation also relating to women Engineers. Her research, an ethnographic study of two building design Engineering consultancies, demonstrated that complicity was achieved at a cost. She identified two dominant identities existing uneasily side by side; an exclusive ‘technicist engineering identity’ and a ‘heterogeneous identity’ embracing the reality of the actual work. Many Engineers oscillated between the two. The ‘technicist’ identity dominated because it converged with available masculine identities, allowing the full performance of the latter by recalling the stereotypes of ‘hands on’ work which is productive and powerful. This identity was problematic for women who more readily related to the scientific base of Engineering (heterogeneous identity) than its physical manifestation. Unlike many of their male counterparts, women had to create ‘inauthentic’ gender identities for themselves and hence their perception and experience of being ‘real’ Engineers was likely to be more fragile than that of men’s. Faulkner has called for greater awareness of the ‘gender trouble’ produced by this restrictive stereotype of the ‘technicist’ as the first step towards the inclusion of a wider range of identities in engineering. Savage and Witz (1992) observed that women working in SET have to deal with a constant tension of trying to be a women yet not behaving like one (also Greed 1991 and Adam et al 2006).

The stereotype of the ‘technicist’ is one example of a ‘gendered sub-text’: Gagliardi (1986) described organisational ‘talk’ and organisational discourses as the primary means by which scientific institutions reinforce stereotypes. These stereotypes describe characteristic images of the kind of people that should occupy senior positions (Kanter 1977). The image is one of senior managers with subordinated personalities, who are emotionless (Schwartz 1996) without domestic commitments (Bagilhole 1985). These are employees which Acker (1992) termed ‘ideal workers’, who are apparently gender neutral. However, the use of the male pronoun in Engineering when referring to managers is an example of how the sub-text prefers one sex over the other and operates to render women invisible and inappropriate (Faulkner 2000). Significantly, in the context of a workplace endorsing a ‘long hours’ culture requiring presenteeism, the 24/7 manager who is constantly ‘on call’ in the technology based SMEs (Wynarczyk and Renner 2006), or the geographically mobile science academic in search of promotion, operating internationally (Halvorsen 2002, Ward 2000, Griffiths et al 2007, Ackers and Gill 2003) is more likely to be male. Fewer women than men are able to make a commitment to the exigencies of this type of senior post as they try to juggle their commitment to work with greater domestic responsibilities.
Finally, there is a distinct body of literature about the pipeline in the science departments of UK Universities. Managerialism has grown, introduced by successive governments in the UK since 1990s to improve the efficiency and quality of these institutions whilst increasing their capacity for student numbers (Halford 2003, Brooks and MacKinnon 2001, Crompton 2001, Deem 2003, Deem and Brehony 2005, Barry et al 2003, Deem and al 2000). Research has highlighted the historical homosociability and homogeneity of management structures in universities, resulting in intimate connections between men’s interests and managerial objectives. Male cultures at institutional and departmental level become normalised and no process remains neutral despite sector-wide commitments to equality of opportunity. Looking at science occupations specifically, Leonard has studied the type of posts created through restructuring the management hierarchy and concluded that a focus on finance, commercialisation and facilities management have strong masculine associations which have had negative consequences for women’s promotional prospects (Leonard 1998). Others have looked that the knock on effect on workplace culture and concluded that managerialism can give rise to a ‘bully-boy’ culture in which men fair better than women (Leathwood 2000). Among the new range of professional identities created by managerialism, women in middle range positions wanting to advance their careers have been left with fewer choices of positive identities to follow (Barry et al 2006).

Finch (2003) has argued that Higher and Further Education Institutions should be treated as a phenomenon in their own right rather than another illustration of a labour market sector. Academics are an unusual profession in that an individuals’ merit is not solely evaluated by their employer but also by an external audience of academic peers, funders and students/ patients. The tradition of academic autonomy has meant that firstly, the human resources function of universities is under-developed and hence so too is the protection afforded to under represented groups (Wilson 1999, Ledwith 2000). Secondly, the external structures with power over progression, make up another set of obstacles which women have to influence and perform to. The achievement of scientific excellence rests on assessment procedures and systems. Hearn and others have pointed out that having men as chairs of evaluation panels, editors of journals, designers of criteria and the majority of applicants not only ensures their greater reward but also privileges the knowledge which they produce (Hearn 2001). This is particularly visible in science disciplines such as Engineering where men outnumber women in the greatest proportion.

Demonstrating the achievement of scientific excellence is arguably the biggest hurdle to the most senior and prestigious positions in the scientific hierarchy, determining movement along the pipeline. It is also a significant determinant of pay. Its definition and the outcomes of the assessment processes are therefore contentious and have increasingly been scrutinised for gender bias. Blake’s study has shown that fewer female academics (50%) apply for research funding in SET compared with men (59%). However, there were no gender differences in applications for competitive fellowships and the proportions of successful male and female applicants are similar (Blake 2000). However eligibility was an issue in Research Council and Wellcome Trust funding which set criteria preventing those on fixed term employment contracts from applying. This criterion affects proportionally more women than men. Millard’s and Ackers’ contribution to ‘The Gender Challenge in
Research Funding: assessing the European national scenes’ (European Commission 2008:130) examined in detail the gender breakdown of applicants to and award-holders of standard research grants issued by the UK Research Councils. As might be expected, the percentages of women applicants were highest in areas of science where they were most numerous. For example, figures for 2007/2008 showed that women made up 22% of applicants to the Biotechnology and Biological Science Research Council (BBSRC) compared with only 13% to the Science and Technology Facilities Council (STFC). However they noted that women’s success rate for these grants were lower than that of male applicants and only in the case of grants aimed at new researchers did women have greater success in some cases. Some of the explanations why women fail to progress along the pipeline and to secure equal pay relate to their participation in grant funding applications since a successful track record of grant funding awards can be used as a criterion for promotion. They are prevented from a full and equal involvement in research within academic departments for reasons already discussed; a lack of transparency, increased competition and reduced collegiate activity coupled with male networking (Fletcher et al 2007).

POLICY RESPONSES

UK public policy has responded to the analysis of women’s career development in science presented by the pipeline model, but in a piecemeal way and as part of other larger policy agendas; first, to increase the scientific workforce because of the centrality of science for national economic growth and increasingly for global competitiveness; and second to meet the nation’s employment equality obligations as a member of the European Union.

A preoccupation with recruitment to the scientific workforce began as early as the 1960s. A focus on women was first raised by the Dainton Report (1968) as an ‘untapped’ pool of labour at a time when many scientists were attracted to work abroad raising concerns about a ‘brain drain’. Theories of gender socialisation in childhood and assumptions about the popular image of science as ‘dirty’ and ‘uncreative’ informed the actions proposed to attract a greater number of entrants into science qualifications and careers. In women’s case, the onus was on the individual to change her perception and educational choices accordingly. Schools and local authorities adopted policies to encourage girls to choose Mathematics and science subjects. At a national level in the late 1970s, the UK Equal Opportunities Commission (EOC) funded projects to devise ways of presenting science in ways that were interesting to girls. For example Girls into Science and Technology (GIST) and women engineers visiting schools (VISTA). The ambitions of these initiatives lived on in the activities of a number of organisations which were established at the same time. The Engineering Council (an umbrella body for professional engineering bodies) funded Women into Science and Engineering (WISE). The Department for Trade and Industry set up a Promoting Women into Science, Engineering and Technology Unit (www.set4women.gov.uk). Both structures continue to operate seeking to enthuse girls about SET subjects. Women in Science, Engineering and Technology (WiTEC) was formed as a network in 1988 and after more than ten years of networking and project activities related to women
and SET, established itself as a non-profit making European association in 2001. There has been very little evaluation carried out into the effectiveness of these interventions, where conflicting factors make establishing cause and effect notoriously difficult (Clarke 1999). It is impossible to conclude whether subsequent increases in female participation and attainment are due to their activities (Whyte 1986). The most recent trend in this area of policy development has been a retreat from the focus on only women. The lack of take up of science in schools by boys and a falling number of male university entrants, particularly in Physics, has broadened the focus to gender (Glover 2001:75). The Equal Opportunities Commission’s ‘General Formal Investigation into Occupational Segregation and Apprenticeships’, conducted in 2004, is a notable example of public policy of this type with a gender focus.

Policies addressing women’s lack of progress and representation at the highest levels of science has been subsumed within an agenda to promote equal opportunities in UK workplaces, with a few exceptions, discussed below. UK membership to the European Union, supported and pushed forward national feminist campaigns for equal pay and an end to gendered prejudice leading to direct and indirect discrimination, in particular, legislation to recognise the ‘female condition’ in regard to pregnancy, maternity and child-rearing, and to mitigate its impact on women’s chances of securing an equal place with men in the world of work (e.g. Directive on the protection of pregnant women at work 92/85/EEC Oct 1992). Organisations in the public sector have been easiest to influence and most receptive to change. A significant number of institutions implemented family friendly and flexible working arrangements to enable women to achieve better work life balance, trained their managers about the negative consequences of gender stereotypes, and endeavoured to make their processes of recruitment and promotion more transparent and fair. Compliance of UK legislation with EU requirements was finally achieved by the Equality Act in 2006 which consolidated all existing equality legislation. The Act imposes a requirement or ‘public duty’ on all public institutions to promote gender equality in order to demonstrate that discrimination is not taking place (in recruitment, promotion and appraisal processes) and that in areas where women or men are under-represented, barriers are being tackled, for example though gender awareness training for staff or targeted funding or support services. This requirement aims to make gender equality the responsibility of every member of an organisation, to ‘mainstream’ it into the common culture and values (Rees 1998). These measures have benefited women working in science in the public sector, such as Higher Education Institutions and Local Government (Bagilhole 2002, Bennett and Tang 2008, Deem and Morley 2006). Very little is known about their impact in the private sector, except in a relatively small number of large companies which have championed initiatives because they recognise their benefits to the business in terms of better workforce retention. Three major policy strands were pursued in Higher Education Institutions (HEI) which attempted to level the playing field for women and to redistribute some of the rewards of academic endeavour. In 1999, Lord Sainsbury Minister for Science and Sir Robert May, Chief Scientific Advisor to the government, endorsed a high profile initiative called The Athena Project. This project was a product of the HEI Vice-Chancellors’ and Principals’ group with an agenda to remove barriers which discriminated against women and to significantly increase the numbers of women in top positions in the academe by 2007. The
project’s main activity has been to fund a series of mentoring and staff development projects in individual institutions focusing on issues of career advancement and women returners. To improve retention rates in academic employment the HEI Committee of Vice-Chancellors and Principals with the national Research Councils agreed to extend the rights of contract researchers under the Research Careers Initiative (RCI) in 2002, (an employment status disproportionately occupied by women). Part of this agreement provided additional funding to pay for substitute cover should a female researcher become pregnant in order to allow maternity leave to take place and give women a measure of career continuity. The RCI also put in place measures to improve the appraisal, training and career guidance opportunities for contract researchers. In the area of scientific excellence, a portentous initiative was implementation of compensation criteria in the 2008 Research Assessment Exercise and in the adoption of the notion of ‘academic age’ rather than ‘chronological age’ when assessing the research output of academics (a key measure for promotion). Academic age is designed to ensure that career breaks due to family or caring responsibilities do not count against individuals. As such it represents a move towards tangible compensation for all those who undertake the care of dependents alongside paid employment.

In the 1990s, following the ascendance of influential women’s proponents in Tony Blair’s Government and the tenacity of women leading the raft of organisations representing women in SET, a number of distinct policies about gender and science came into being and a more radical approach operated for the following decade. The key milestones were the Government’s White Paper ‘Realising Our Potential. A Strategy for Science Engineering and Technology’ (1993), which had a feminist adjunct: The ‘Rising Tide Report on Women in SET’ (1994) written by the expressly convened Engineering and Technology Committee on Women Science. It recommended that: science companies should adopt equal opportunities policies; the Department for Employment should support scientifically qualified women to return to careers in science; that the ‘female condition’ be recognised through the provision of affordable childcare / tax incentives; and the representation of women on SET advisory bodies should be increased. The Greenfield Report SET Fair (2002) looked specifically at the barriers to women in SET. It was commissioned by the Secretary for State for Trade and Industry, Patricia Hewitt, to provide a more strategic view of how to bring about structural change. An important outcome was the establishment of a national resource centre - the UKRC [www.theukrc.org], representing an investment of approx £13 million between 2004-2011, to address the serious under representation of women in SET at all levels, working with organisations, businesses and individual women. Its vision stated ‘By 2030 we will have an environment in UK SET employment, research and policy making, in which women contribute to, participate in and share the benefit equally to their male counterparts.’ Measurement of the progress achieved using this strategy is awaited with interest.

BEYOND THE LEAKY PIPELINE

At the time of its inception the pipeline metaphor was critiqued by feminist scholars in a number of ways which related to emerging thinking in Sociology. Firstly, its
emphasis on motherhood; placing primary responsibility on individual women for preferring to prioritise their children and families over career development, was challenged for being overly simplistic. It was argued that this premise overlooked the ways in which women’s ‘choices’ are shaped by their perception of the options available to them, which are in turn dictated by a multitude of inter-related factors such as: the cost, availability and reliability of childcare and adult social care (for dependent relatives) (Yeandle et al 2007); the impact of government policies e.g. tax and pensions; family background including their religion; the degree of family support for their career (Rose 1994); the availability of flexible working options and expected hours of work (paid and unpaid) (Bennett and Tang 2006, Fagan 2001); and a women’s personal employment history which may be coloured by experiences of unemployment, job insecurity or difficult working environments (Grant et al 2006). Whilst the ‘leaks’ from the pipeline in terms of female workers leaving science occupations occur at the time of family formation, they may not be freely or easily chosen. Recent research on women’s career development in other sectors has strongly refuted the assumption that choosing family over paid employment shows an ambivalence about their careers. It ignores the very great effort which women invest their employment, the complex and demanding work life balance solutions they devise, and the satisfaction and importance they attach to the product of their endeavours (Bennett and Tang 2006).

Secondly, research across all science disciplines flagged up the mismatch between a linear career path and the reality of many women’s professional lives. In most cases women move between maximum and minimum work commitment according to their life stage and its associated responsibilities. (Crompton 1996, Crompton and Harris 1998, Fagan and Rubery 1996, Ginn et al 1996, Charles and James 2003). Women who return to their career in science after a break to raise a family, or come to science education as mature students, often with a family already established, are not a homogeneous group who experience equal disadvantage (Equaltec and University of Bath 2005). However, they share common issues: the length of their break from employment is a significant factor in their ease and level of re-entry, so too is their level of confidence in their ability to surmount new changes in the industry and their assurance that the culture to which they are returning is sympathetic towards people with family dependents (Hughes 2002, Panteli and Pen 2001, Morley 2007). At this juncture, evidence suggests that women employ different strategies to make work fit life. These include: pursuing technical rather than managerial career paths to gain greatest control over their working hours and levels of pressure; and stepping sideways into more flexible occupations requiring a scientific grounding such as health informatics, science media or publishing (Equaltec and Roberts 2007). Many women choose to halt their progression at a level which they can sustain, or even accept posts below their proven ability again in order to retain control of workloads for the time that domestic and caring responsibilities are most demanding (Glover 2005, Evans et al 2007). This phenomenon of working below your proven potential is not captured by the pipeline model, built as it is on the assumption of incremental stages relating to level of qualification and experience.

Thirdly, the pipeline model has been accused of being andro-centric due to its reliance on a gendered measure of qualification (Hodgson et al 2000). The
description of a science career as a series of qualification segments is said to reinforce a view that women’s lack of progression is due to their own lack of academic ability (Johnson 1987) shifting attention away from the patriarchal relationships in which they work and for whose benefit the system operates. Women say they have to out-perform men to be seen to be worthy to advance. Feminists such as Cockburn (1985) identified the invisible barriers between the segments, controlled by a male dominated management structure and trade union, to the advantage of men. This critique draws on the more fundamental contention that science is not objective: men’s presence and output in science is privileged as ‘the norm’ against which women’s contribution and progress is measured. Bagilhole’s and Goode’s (2002) work looking at managers in Higher Education found that the appraisal processes and pursuit of external funding normalises a highly competitive role model focused on producing quantifiable outputs. Women’s efforts to gain recognition for the alternative ways in which they contribute to academic life (for example pastoral student care, course administration) face considerable opposition or non attention (Thomas 2007). Fewer women than men participate in the evaluation processes of academic funding proposals or research publications. Fewer women sit on decision making boards for appointments, promotions or funding allocation. Women cannot easily match the exclusive access to research cultures, ideas and partnerships conferred on men by their networks (Deem and Brehony 2000, Fletcher et al 2007). Hence there are countless indirect advantages enjoyed by men. Perhaps most seriously men’s academic interests have come to dominate the questions asked by science and the analysis of the data collected, suggesting that knowledge production is itself gender biased (Hearn 2001). Others using a similar line of argument have highlighted the paucity of scientific research findings than can result from ‘gender blindness’ citing examples of research undertaken with only male participants to produce medication which is assumed to be suitable and safe to be used by women, with disastrous consequences. The underlying conclusion is that ‘good’ research is gender sensitive. Rees (2004) has observed that many scientists, including women, are quick to maintain that the processes in science are neutral and merit-driven and that its inherent ‘objectivity’ means that science cannot be gender biased. In the face of the numerical evidence this could be described a ‘false consciousness’. In a similar vein, Simpson (1994) suggested an explanation for why the pipeline model continues to be popular. She found that women themselves are not always aware of the external barriers to their progression, attributing their success solely to internal qualities. In an environment where women continue to be such a minority, survival may necessitate the adoption of male values and result in their assimilation (also Powell, Bagilhole and Dainty 2006).

Table 1 summaries the theoretical assumptions which underpinned the pipeline model when it was first conceived and the barriers to women’s advancement which it recognised. Each of these aspects has been taken up in subsequent qualitative research and we have now a more grounded and sophisticated understanding of the lived experience of female scientists. The final column of the diagram attempts to capture these more recent debates discussed earlier in the paper, to begin a discussion of what is beyond the ‘leaky pipeline’.
BEYOND THE LEAKY PIPELINE: CONSOLIDATING UNDERSTANDING AND INCORPORATING NEW RESEARCH ABOUT WOMEN’S SCIENCE CAREERS IN THE UK

Table 1. Beyond the Leaky Pipeline: Current and Future Research Directions

<table>
<thead>
<tr>
<th>Phenomenon encapsulated in the leaky pipeline</th>
<th>Theoretical contributions</th>
<th>Barriers / obstruction identified</th>
<th>Beyond the leaky pipeline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low entry into science careers</td>
<td>Stereotypes of:</td>
<td>Girls’ attitudes towards science qualifications,</td>
<td>Positive stereotypes of future selves (pleasure and leisure interests)</td>
</tr>
<tr>
<td></td>
<td>i) ‘women’s work’, ii)</td>
<td>Gender blind teaching practices / environments,</td>
<td>From binary dualisms to multiple subjectivities</td>
</tr>
<tr>
<td></td>
<td>women’s aptitudes, and</td>
<td></td>
<td>Dispelling notions of the ‘traditional’ student/employee by embracing diversity</td>
</tr>
<tr>
<td></td>
<td>iii) scientific occupations</td>
<td></td>
<td>Gender-aware teaching</td>
</tr>
<tr>
<td></td>
<td>Binary dualisms based on essential sex differences</td>
<td></td>
<td></td>
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</tbody>
</table>

Retention of female scientists / early exit

<table>
<thead>
<tr>
<th>Phenomenon</th>
<th>Theoretical contributions</th>
<th>Barriers / obstruction identified</th>
<th>Beyond the leaky pipeline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retention of female scientists / early exit</td>
<td>Organisational policy:</td>
<td>Availability of part-time working, long hours culture</td>
<td>Reconceptualising workplaces: time and location</td>
</tr>
<tr>
<td></td>
<td>work life balance</td>
<td>Women’s choice of motherhood over paid employment</td>
<td>Appreciation of women’s commitment to employment</td>
</tr>
<tr>
<td></td>
<td>Preferences of women</td>
<td></td>
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</tbody>
</table>

Progression of female scientists

<table>
<thead>
<tr>
<th>Phenomenon</th>
<th>Theoretical contributions</th>
<th>Barriers / obstruction identified</th>
<th>Beyond the leaky pipeline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Progression of female scientists</td>
<td>Gendered workplace cultures (patriarchy),</td>
<td>Few senior women, women over-represented in a small range of ‘flexible’ science occupations,</td>
<td>Issues of governance and women’s representation in science hierarchies</td>
</tr>
<tr>
<td></td>
<td>Gendered measurements of achievement</td>
<td>Female coping strategies, faced with harassment</td>
<td>Branching career paths, new occupations and industries</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Notion of the ‘ideal’ worker – male as the ‘norm’</td>
<td>Revaluation of women’s contribution (caring and administering)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Maximising women’s proven potential (returners and tackling stalled careers)</td>
</tr>
</tbody>
</table>

On the question of women’s entry to the pipeline, starting with their choice of science qualifications at school, academic scholarship has moved a long way from an acceptance that essential sex stereotypes account for the differences in male and female engagement. Research into the disciplines of Physics and ICT have provided insights into the subjective positions of female pupils and students, foregrounding the gendered discourses and plethora of gendered binary opposites which they negotiate on a daily basis in the science classroom. These subliminal discourses and associations have been shown to have a negative impact on young women’s assessments of their own abilities and of the relevance of science to their future selves. There is a striking difference between many young women’s and men’s
orientations to science; more young women are motivated by altruistic opportunities (such as those offered by a medical career) and more young men continue to follow what seems an obvious and ordained path from male hobbies and sociability to a job in science. The concept of ‘belonging’ (Faulkner 2005) is a powerful one in explaining women’s decision to go forward along the stages of the pipeline, alongside the contribution of gender-aware teaching practices, role models and careers advice which challenge the status quo. In the future, research (Hughes 2001, Mendick 2005 among others) suggests that curriculum changes to accommodate women’s social interests, to instil a sense of pleasure in performing science tasks, alongside the inclusion of a wider range of positive female subjectivities should be an additional dimension of public policy intervention. Thinking about the appropriateness of describing a science career as a single fixed sized pipe, it would be possible to redraw the model so that its aperture fused with pipes from other disciplines allowing the confluence of socio-science curricular to feed into a science career, permitting and encouraging specialisation later in the entry process and affording a cross fertilisation of science teaching approaches with those of social science disciplines.

Current research suggests that the pipeline’s explanation of progression as discrete sections resting on sequential attainment and experience should be problematised to better reflect women’s actual experience. It has shown that women select and pursue career routes which offer manageable hours and workloads. As a result they can find themselves in female enclaves which do not command the prestige or remuneration of other specialisms. They may even find themselves ‘trading water’; reluctant to advance for fear of losing the work-life balance compromise they have struck, or worse, unable to advance because their role has no obvious progression route. For some science disciplines, the pipe bulges in its middle sections as women get stuck or sidelined into dead-end branches. The model also fails to capture the proliferation of occupations which combine scientific skills with other disciplines such as journalism, sport, or new areas of technology such as health informatics and telecare which for some women offer mid career re-entry routes. Finally, the suggestion that the pipeline narrows consistently to reflect not only the decreasing number of women at more senior levels in science organisations but also the smaller number of positions at each superior grade, again mis-represents the reality of science hierarchies where research has shown that some grades are extremely difficult for women to attain as promotion to them rests on measurements of excellence which are gender blind, administered largely by male dominated panels. Hence the narrowing the pipeline presents a bottleneck for women who fail to break through the glass ceiling to the next grade.

Where does this analysis leave the leaky pipeline model? The model can be viewed as a snapshot of our understanding in the 1980s. It has already provided fertile ground for a critique and elaboration of women’s experience and position in science organisations. If it were redrawn now to reflect contemporary research it would have many more branches, bottlenecks, and capped sections, reflecting the increasing sophistication of our understanding of career trajectories. Yet further explanation is needed. The research evidence suggests that different science disciplines present pipelines of different gauges and complexity, wherein the gendered and patriarchal processes of generating scientific knowledge and of rewarding this endeavour are
more intractable and exclusive than others. A number of theorists have raised questions about the effect of gender in its diversity - curious about the diverse experience of men, and of the effect of race and class on an individuals’ entry choices and progression prospects. As the globalisation of the scientific workforce continues, facilitated by changes in marketplaces and technology these issues will gain greater significance. It will no longer be enough to consider policy responses to the issue of gender and science operating in a UK context alone.
## APPENDIX 1. SUBJECTS REFERRED TO IN THE COMMONLY USED ABBREVIATIONS FOR SCIENCE IN THE UK

**SET** - Science, Engineering and Technology  
**STEM** - Science, Technology, Engineering and Mathematics

<table>
<thead>
<tr>
<th>Subjects allied to Medicine</th>
<th>Computer Science</th>
<th>Engineering &amp; Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anatomy, Physiology &amp; Pathology</td>
<td>Computer science</td>
<td>Broadly-based programmes within engineering &amp; technology</td>
</tr>
<tr>
<td>Pharmacology, Toxicology &amp; Pharmacy</td>
<td>Information systems</td>
<td>General engineering</td>
</tr>
<tr>
<td>Medical Technology</td>
<td>Software engineering</td>
<td>Civil engineering</td>
</tr>
<tr>
<td>The following subjects were excluded from Subjects allied to Medicine: Broadly-based programmes within subjects allied to medicine; Complimentary medicine; Nutrition; Ophthalmics; Aural &amp; oral sciences; Nursing; Others in subjects allied to medicine.</td>
<td>Artificial intelligence</td>
<td>Mechanical engineering</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Biological Sciences</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Broadly-based programmes within biological sciences</td>
<td></td>
<td>Broadly-based programmes within engineering &amp; technology</td>
</tr>
<tr>
<td>Biology</td>
<td></td>
<td>General engineering</td>
</tr>
<tr>
<td>Zoology</td>
<td></td>
<td>Civil engineering</td>
</tr>
<tr>
<td>Genetics</td>
<td></td>
<td>Mechanical engineering</td>
</tr>
<tr>
<td>Microbiology</td>
<td></td>
<td>Aerospace engineering</td>
</tr>
<tr>
<td>Sports Science</td>
<td></td>
<td>Naval architecture</td>
</tr>
<tr>
<td>Molecular biology, biophysics &amp; biochemistry</td>
<td></td>
<td>Electronic &amp; electrical engineering</td>
</tr>
<tr>
<td>Others in biological sciences</td>
<td></td>
<td>Production &amp; manufacturing engineering</td>
</tr>
<tr>
<td>The following subjects were excluded from Biological sciences: Botany; Psychology</td>
<td></td>
<td>Chemical, process &amp; energy engineering</td>
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<table>
<thead>
<tr>
<th>Physical Sciences</th>
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</thead>
<tbody>
<tr>
<td>Broadly-based programmes within physical sciences</td>
<td></td>
<td>Others in engineering</td>
</tr>
<tr>
<td>Chemistry</td>
<td></td>
<td>Minerals technology</td>
</tr>
<tr>
<td>Materials science</td>
<td></td>
<td>Metallurgy</td>
</tr>
<tr>
<td>Physics</td>
<td></td>
<td>Ceramic &amp; glasses</td>
</tr>
<tr>
<td>Forensic &amp; archaeological science</td>
<td></td>
<td>Polymers &amp; textiles</td>
</tr>
<tr>
<td>Astronomy</td>
<td></td>
<td>Materials technology not otherwise specified</td>
</tr>
<tr>
<td>Geology</td>
<td></td>
<td>Maritime technology</td>
</tr>
<tr>
<td>Ocean Sciences</td>
<td></td>
<td>Industrial biotechnology</td>
</tr>
<tr>
<td>Physical &amp; terrestrial geographical &amp; environmental sciences</td>
<td></td>
<td>Others in technology</td>
</tr>
<tr>
<td>Others in physical sciences</td>
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<table>
<thead>
<tr>
<th>Mathematical Sciences</th>
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<th></th>
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<tbody>
<tr>
<td>Broadly-based programmes in mathematical sciences</td>
<td></td>
<td>Architecture, Building and Planning</td>
</tr>
<tr>
<td>Mathematics</td>
<td></td>
<td>Architecture</td>
</tr>
<tr>
<td>Operational research</td>
<td></td>
<td>Building, Landscape design</td>
</tr>
<tr>
<td>Statistics Others in Mathematical sciences</td>
<td></td>
<td>Planning (Urban, Rural and Regional)</td>
</tr>
<tr>
<td>Others in mathematical &amp; computing sciences</td>
<td></td>
<td>Others in Architecture, Building and Planning</td>
</tr>
</tbody>
</table>

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