Women in Academic Science

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Abstract

Women comprise a small minority of total tenure-track faculty with somewhat larger minorities in the humanities and social sciences and very small minorities in the physical sciences and engineering. Their rank distribution is pyramid shaped—large numbers are concentrated at the lower ranks whereas only a few reach the highest rank of full professor. They advance less rapidly on the academic ladder compared to their male colleagues. These characteristics are surprisingly similar cross-nationally. Underlying gender inequality in academia is the traditional sex-typing of scientific research as a masculine enterprise. The scientific disciplines for which women are thought to be particularly unsuitable are mathematics, the physical sciences, and engineering. In addition to stereotypes, several obstacles inhibit women's careers, such as marital and parental obligations that coincide with the first crucial years of the academic career; limited geographical mobility; the reluctance of faculty men to serve as mentors and collaborators; the relative absence of female role models; exclusion from informal networks, genderized stereotypes, and discrimination. An important reason for the persistence of gender inequality in academic science is that women are less integrated into social networks, namely they have smaller amounts of 'social capital' although they have similar 'human capital' to male colleagues.

Women in academic science provide a particularly interesting case for examining the effects of gender on scientific and professional careers. It might be assumed that inequalities between the sexes in this area would be less pronounced than in other occupational spheres in which physical strength, technical skills, or leadership and authority are involved. Nevertheless, as Long and Fox (1995, 45) state, 'Science is an institution with immense inequality in career attainments. Women and most minorities, as groups, have lower levels of participation, position, productivity, and recognition than do white men'.

Comparing statistics of faculty women in academic science showed remarkable cross-national similarities in the proportion, position, and distribution across scientific fields, and academic ranks in most Western developed countries.

Figure 1. Women faculty in academia

WOMEN FACULTY IN ACADEMIA ARE
– A SMALL MINORITY OF THE TOTAL FACULTY
– CONCENTRATED IN LOWER RANKS
– UNEVENLY DISTRIBUTED AMONG DIFFERENT SCIENTIFIC FIELDS
– ADVANCE LESS RAPIDLY THAN COMPARABLE MEN
– OVERREPRESENTED IN NON-TENURE TRACKS
– ONLY A SMALL PERCENTAGE REACH THE TOP
– SMALL IMPROVEMENTS HAVE OCCURRED IN THE LAST DECADE

Women comprise a small **minority** of total tenure-track faculty (about 20 to 30%), with somewhat larger minorities in the humanities and social sciences and very small minorities in the physical sciences and engineering (about 5% to 10%). Their rank distribution is pyramid shaped—large numbers of women are concentrated in the lower ranks whereas only a few reach the highest rank of full professor. Furthermore, they advance less rapidly on the academic ladder compared to their male counterparts, and they are overrepresented in non-tenure tracks, and temporary and part-time posts (about 40–50%).

Metaphorically, the careers of women in academia can be described as follows: an iron gate at the entrance, then a sticky floor, a glass ceiling at the top, and a hurdle track in between.

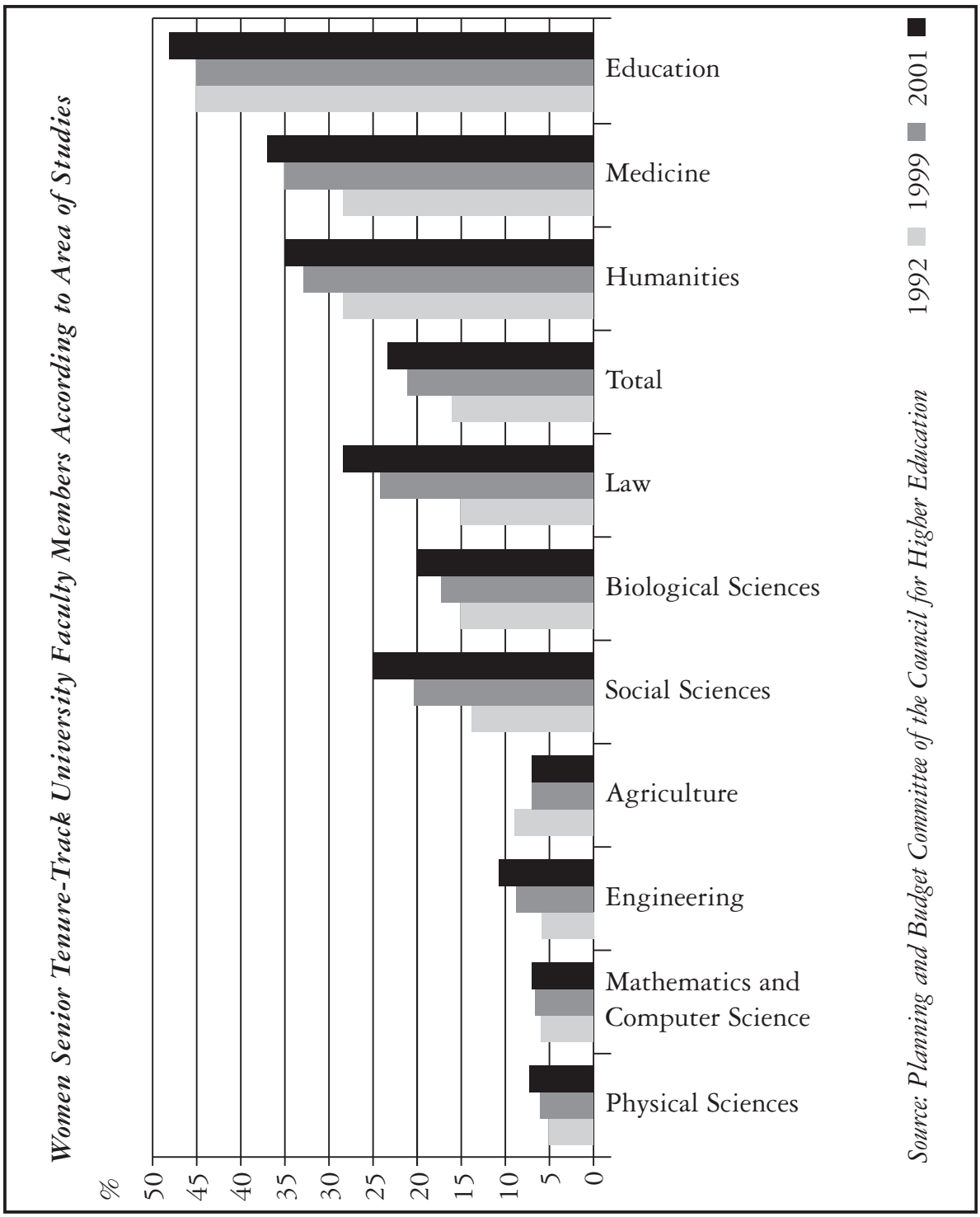
It is nevertheless important to note that the participation of women in higher education as students and graduates has changed dramatically. In most countries they constitute 50% or more of the student body and almost as much among the higher degree recipients (but only about 25% of faculty members).

Stereotypes

Underlying the fact that women are a minority in academic science is the traditional sex-typing of scientific research as a masculine enterprise. Widely held stereotypes assume that women are not suitable for careers in science, because they, presumably, lack the capabilities and characteristics to do creative intellectual work; that they do not have the required mathematical

abilities; that they are not rational and independent as scientists should be; and that it is in their 'nature' to be more concerned with their children than with developing their professional careers. It is unfortunate that some women have themselves internalized these perceptions and attitudes.

Figure 2. Comparing scientific fields



The scientific disciplines for which women are thought to be particularly unsuitable are mathematics, the physical sciences, and engineering. In these fields women's participation is much lower than in the social sciences, law, the life sciences, medicine, the humanities, and education, as shown in Figure 2, which represents the distribution of faculty women among scientific fields in Israel and its changes from 1992 to 2001. In principle, this distribution is similar in other Western countries.

Numbers

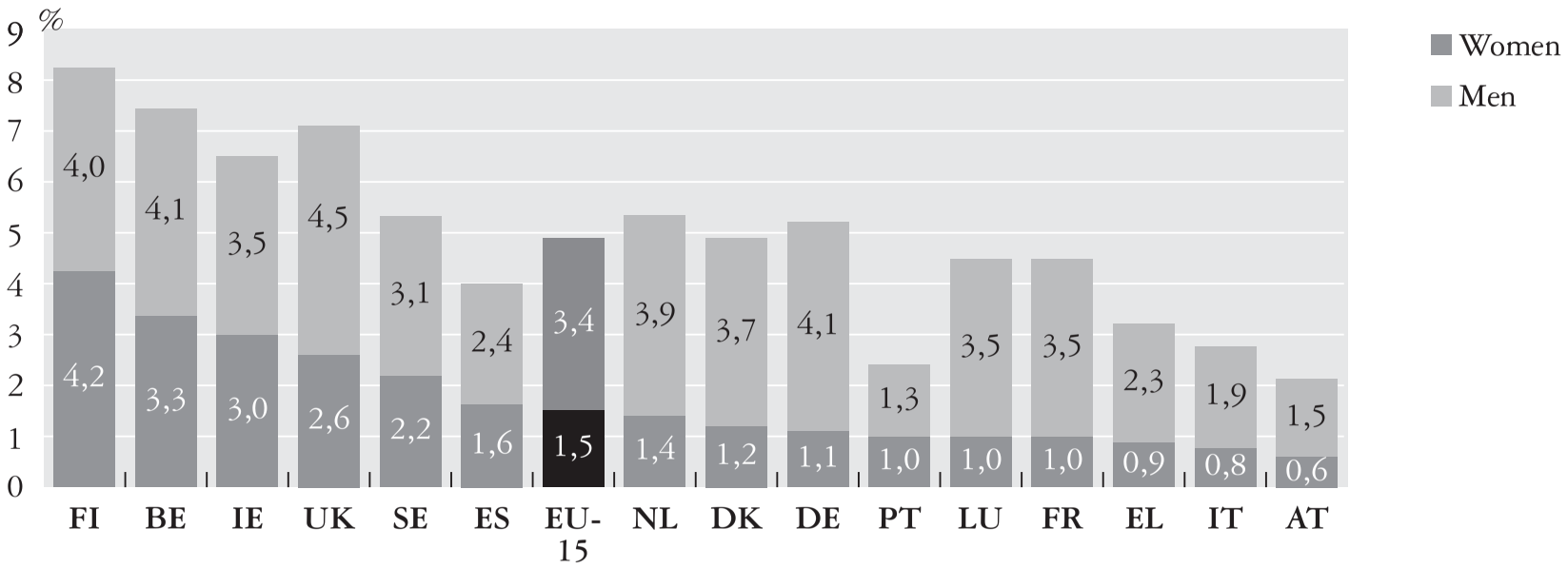
Belonging to an underrated minority leads to the drawing of boundaries, rejection from informal networks, marginalization, and isolation and thus limits performance and career progress.

Paradoxically, the fate of women in the natural sciences in terms of accomplishments and advancement is better than that of their sisters in the humanities although they constitute a smaller minority in this discipline. Several studies (Cole & Zuckerman 1987; Kyvic 1990; Toren 2000) found that women's ranking in the natural sciences is closer to that of their male colleagues, whereas in the humanities and social sciences the rank discrepancies between the sexes are larger.

One explanation of these differences is that the natural sciences are characterized by greater clarity and consensus regarding the criteria for judging the worth of scientific contributions; hence evaluation of the quality of research is more objective and consensual. Under these conditions the effects of gender stereotypes are neutralized or minimized. When, however, such criteria are ambiguous or lacking, it is difficult to assess the quality of performance, and diffuse irrelevant status characteristics, such as gender permeate the framework and affect participants' attitudes and behaviour.

Figure 3.

Distribution of Scientists and Engineers by sex as a percentage of the total labour force, EU Member States, 2001[(1)]



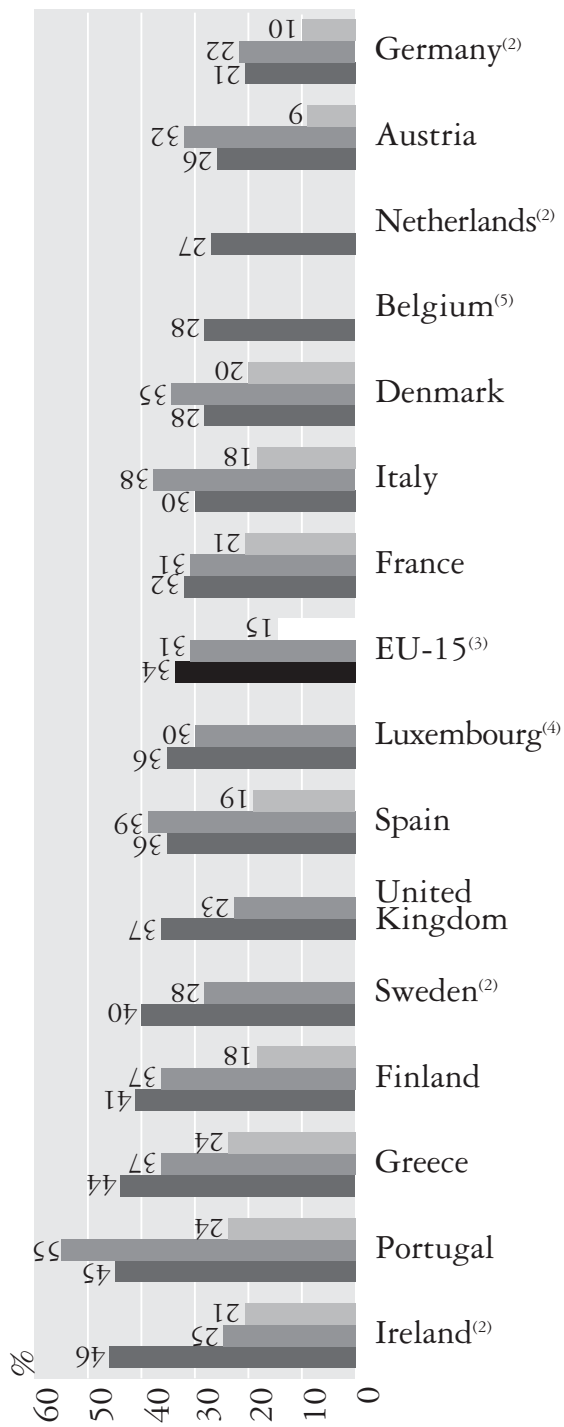
Source: *Eurostat, S&T statistics, Community Labour Force data. Graph adapted from Statistics in Focus, Catalogue No. KS-NS-03-005-EN-C.*

Notes: [(1)]Exceptions to the reference year: AT (1997); SE & UK (2000). These exceptions also apply to the EU-15 total.

Information on Scientists and Engineers (S&Es) is derived from the labour force surveys, and refers to "Physical, mathematical and engineering" occupations and "Life science and health" occupations which are subgroups 21 and 22— of the ISCO major group 2 "Professionals". It does not therefore include any of the people working in social or agricultural sciences that are included in the HRST data. Focussing on S&Es appears to exlude a disproportionate number of women since the proportion of women tails off markedly in many Member States. The countries with the most S&Es in the labour force are generally the ones with the highest proportions of women.

Figure 4.

Percentage of researchers who are women by sector in EU Member States, HC, 2000[1]



Source: *Eurostat, S&T statistics; DG Research, WiS database.*

Notes: [1]Exceptions to the reference year: IT (HES), LU (HES & GOV), SE (HES): 2001; DK (BES), DE (BES), EL, ES (BES), IE (GOV, BES), IT (GOV), PT, SE (GOV): 1999; AT: 1998.
[2]FTE as exception to HC: SE (GOV only); IE (GOV & BES only).
[3]EU-15 estimate excludes BE & NL for GOV and BE, LU, NL, SE & UK for BES.
[4]Data provisional.
[5]Data not official.

The overall presence of women as researchers is lower than we would have expected from the graduates and HRST figures. Although the sex breakdown is only available for 70% of the BES researchers in the Member States, the scarcity of women in the BES is more extreme than in public sector research (HES & GOV). Portugal is the only country that has more than 50% women researchers in a sector (GOV). It is useful to interpret these figures alongside results from Figures 1.2.a and 1.2.b to see where the feminisation of education is having an impact on the feminisation of research.

Comparing rank distribution

As noted above, the rank distribution of women is in general pyramid shaped, whereas that of their male colleagues takes the form of an inverted pyramid. The small proportion of women in the top rank of full professor in particular, is a trans-national pattern.

Table 1. Statistics for women in academia (all disciplines). Percentage of female faculty members in different ranks

Country	Year	A Full	*A** 2000*	B Associate	C Assistant	D
Austria	1996/97	4	*6*	7.8	21.9	37
Netherlands	1996	4.6	7	7.2	18.9	
Ireland	1995/96	4.9	*6.3*	6.5	15.8	28.8
Germany	1996	5.1	7.7	8.5		
Belgium	1996	5.7	7	7.8		
Switzerland	1996	5.7	-	19.2		
Denmark	1995	6	*8.3*	19	29	
UK	1994/95	7.3	*12.5*	16.4	30.9	32
Sweden	1995/96	8	*13.8*	20	43	
Iceland	1996	8	*12*	22	45	
Norway	1995	8	*13.3*	25	39	
Spain	1994	10	*15*	33		
Italy	1993	10.1	*14.6*	25.3	39.8	
Finland	1995	12.8	*18.9*	22		
France	1995/96	13.2	*16*	29.9	37.1	

Source: Mary Osborn, Women in Science: Proceedings of Conference, Brussels (1998).
*** European Commission, Women in Science: Statistics and Indicators (2003).*

Comparing statistics for 16 European Union countries in the mid-1990s we see that women constitute only 6% to 10% of the highest rank (full professor; rank A) on the academic hierarchy. In some countries this proportion is even lower, notably in Germany (5.1%), Ireland (4.9%), the Netherlands (4.6%), and Austria with 4% in 1997. In the United States on the other hand, women faculty members already broke through the ten percent ceiling by the second half of the 1990s. The favourable American record is largely due to the affirmative action policy enacted in academia in the 1980s.

Ten percent women in the highest echelons appears to be a 'magic number!' This magic number is more or less the proportion of women that we find at the top of traditionally male high-status occupations, such as the professions, science, politics, and management. It seems that after 25 years of talking about gender equality, the ceiling blocking women's career progress in prestigious male occupations is still quite low.

Typical career pattern

Research on women faculty has identified a variety of obstacles inhibiting their career development and advancement. For example, marital and parental obligations that coincide with the first crucial years of the academic career; the reluctance of faculty men to serve as mentors and collaborate with women students; limited geographical mobility; their minority status in academia; the relative absence of female role models; genderized stereotypes, exclusion from informal networks, and discrimination.

An interesting question raised from a career-cycle perspective concerns the location of major hurdles along the career trajectory. Are obstacles and barriers situated mainly at the point of recruitment and career entry? Throughout career progression? Or are women stopped just before reaching the top?

Various metaphors have been applied to describe this problem—the best known of which is the 'glass ceiling'. This popular image depicts the phenomenon of women in traditionally male occupational areas (business, government, academia, and the military), not making it to the very top of

the organizational or professional hierarchies. Others have noted that the 'bottle neck' is situated at the point of recruiting and entrance to the academic career. Another image is the 'leaking pipeline' that refers to women's dropping out during their advanced studies or in the course of early career stages.

I argue that the concept which best captures faculty women's predicament is that of a 'hurdle track' denoting that obstacles are recurrent, appear at various career junctures, and their effects are interdependent and cumulative.

These processes were called 'The Matthew Effect in Science' by Robert Merton who wrote: 'In the domain of science, as in other institutional domains, initially small differences amplify in later stages of the individual career and aggregate into strongly skewed distributions of resources, role performance, and rewards' (Merton, 'Foreword' in Sonnert 1995, x–xi; see also Merton 1988).

The concept of 'accumulation of advantage/disadvantage' is very important for understanding women's careers when comparing them to men's. This is illustrated by the well-known fact that, on average, faculty women stay longer in each rank than their male colleagues. Moreover, they attain each successive rank increasingly later and the discrepancy in rank between genders grows over time in the shape of a fan, instead of decreasing as claimed by some researchers.

This can be seen by looking at faculty members in a department or university; it also appears in the so-called 'scissors' diagrams' for whole countries. Annex 3 of the report of the European Commission: *Women and Science, Statistics & Indicators 2003* depicts the relative share of women and men in a typical academic career in thirty European countries (including Eastern Europe).

In several countries more female than male students start their studies for the first degree. Nevertheless the discrepancy between women and men, in favour of the latter, grows with the advancement on the academic hierarchy in all countries, with the largest gap at the top of the ladder, i.e. the rank of full professor.

The persistence of the situation

The disturbing fact is the persistence of this situation.

Looking at women in academic science shows that their proportion, promotion, and position have not changed significantly in recent decades. The changes that we are witnessing are slow, incremental, and evolutionary transformations that according to one author will bring about gender equality in academia in 475 years!

Why has the situation not changed more rapidly and fundamentally in recent decades since we have started to realize and analyze the problem of gender inequality in academia?

First, organizations, including universities and academic institutions, are conservative social systems that usually continue doing what they have always done, unless something forces them to change their traditions. Universities have been male-made and male-dominated for long periods of time and people do not tend to give up their historical privileges willingly. Furthermore, people prefer to contact and interact with others who are like them, such as marriage partners, friends and co-workers ('Birds of a feather flock together'). In fact, the most popular way of recruiting workers in organizations is by informal methods—asking somebody you know to recommend somebody he/she knows personally. This accounts for the resemblance between old and new recruits in an organization, a phenomenon that Kanter (1977) called 'homosocial reproduction'. Since academia has been dominated by white men it is understandable that the penetration of 'others', e.g. women and people of colour, into this institutional sphere is not welcome or easy.

Second, the claim that higher education is an area where evaluations are based on excellence and merit, and is free from other influences and considerations, is not born out by the empirical data. The number of scientific publications and their quality and the quality of teaching certainly are a basis for evaluation and decision-making concerning academic personnel. Nevertheless, other considerations, conscious or unconscious, play a role too. There are all kinds of factors that influence these processes in spite of the claim that they are free of any non-relevant intrusion, such as stereotypes, political interests, scholastic disagreements, and personal sympathies

and sentiments. A good study of this issue is the famous study by Wenneras and Wold, 'Nepotism and Sexism in Peer-Review' (1997) which shows that gender and personal acquaintance play an important part in judging the quality of research proposals (in biomedicine).

Social networks

I propose that a central impediment to women's career development in institutions of higher education is the discrepancy between their human and social capital. Faculty women have similar *human capital* to their male colleagues. Human capital consists of education, training, experience, skills and motivation.

Figure 6. Human, social, and professional capital

Human Capital	**Social Capital**
Ability	Network Relationships
Education	Information
Training and Skills	Support
Knowledge	Mentoring
Experience	Marketing
Motivation	
Academic Degree	
Professional Capital	
Research Grants	
Appointments and Promotion	
Equipment and Space	
Participation in Research, Publications, and Meetings	
References, Prizes	
Reputation	

Women, however, have less *social capital*, namely—fewer contacts with powerful members and interactions with colleagues, they are less integrated into collegial networks and therefore lack important resources, such as information, trust, encouragement, support, mentoring, participation in research, and referrals to other academics.

Human and social capital produce *professional capital*: grants, prizes, publications, citations, participation in scientific meetings, and other necessary resources for research and career advancement (e.g. equipment and space as revealed in the MIT Report 1999). While men accumulate such resources in the course of time, women are generally discriminated in these respects and their disadvantages increase.

An example of how social capital works is the professor who picks up the phone and recommends his male Ph.D. student to a colleague for a job. He describes him as brilliant and so on, thus marketing him and building his reputation. The same professor will be more reluctant to do the same for a female Ph.D. candidate because he is uncertain whether she is really good, she might marry and leave, and perhaps the whole thing will not look so good and his own reputation will be in danger.

The evaluation system is biased in favour of men. Women are assessed differently than male colleagues; they are tested and judged more rigorously and critically, and more evidence is needed to prove their worth, because they are perceived as different, not as 'one of us' and do not completely belong. For women to be integrated into the scientific-academic community as equals they have to obtain more social capital, because talent, competence, commitment, and performance (human capital) are not the only attributes that determine career success of academic scientists.

The relative lack of social capital is not the only factor that creates gender inequality; limited social ties nevertheless account in part for women's dropping out in the course of their academic careers, their minority status, slower promotion, crowding in the lower ranks of the academic hierarchy, and underrepresentation in decision-making bodies.

What can be done to change the situation and accelerate the process toward more gender equality in academia?

This is a difficult question and there are no simple answers. In general, students of this problem agree that 'no single policy can be expected to

produce success', and that a variety of efforts and interventions are more advantageous.

The sources of these interventions can be different—formal and informal, external and internal, cultural and structural. At the cultural level, the uprooting of stereotypes against women in science and engineering is important because that is where it all begins. This is a complicated task.

At the structural-systemic level, institutions of higher education themselves can do much to promote women's participation and development, such as child care facilities, allocation of post-doctorate fellowships, mathematical and methodological training, mentoring, encouraging, collaboration, and provision of research opportunities and resources.

Active intervention from outside is also necessary for achieving our goal of gender equality in science, as well as in other areas of life. Local governmental policy and federal legislation are very important in this respect (e.g., the Parliamentary Committee for the Advancement of Women), and so is the influence of international bodies like the UN.

Conclusion

Promoting gender equality in the scientific community is a worthy cause because of its moral justification and its potential advantages.

Women scientists differ from men not only in their relationships with colleagues and students or the style of managing their laboratories. They frequently 'do science' differently—ask other kinds of questions, use different methods of research, use different facts as evidence, and approach their subject from new angles.

The growing diversification of the faculty in scientific institutions in terms of gender and other minorities is beneficial because it provides an opportunity to consider a variety of scientific approaches and understandings, and promotes intellectual exchange and interaction of different ideas, which is of crucial importance for the creation of new knowledge and innovation.

Note

The original dictum in the New Testament states that 'For whosoever hath, to him shall be given, and he shall have abundance: but whosoever hath not, from him shall be taken away even that he hath' (Matt. 25:29, KJV).

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