

Ten years GASAT activities in a changing Europe

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October 25-29 1992



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Vol. III

Ten years GASAT activities in a changing Europe

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Ten years GASAT activities in a changing Europe

PROCEEDINGS
of the conference October 25-29 1992

Edited by

Marijke van Vonderen
Oda Weyers

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PREFACE AND ACKNOWLEDGMENTS

This book contains the *Proceedings* of the third European GASAT conference, held in October 1992 in Geldrop, near Eindhoven, The Netherlands. Main objective of the conference was to share and discuss developments in a changing Europe and their effect on participation of women in science and technology.

The accepted papers of the conference have been published in two Volumes of Contributions. This, third, volume contains the text of the four keynotes and reports of the papersessions, workshops, home groups, postersessions and the East-West Forum.

Many people contributed to the success of this conference. We are thankful to the planning committee, the Dutch advisory board and the International advisory board for their suggestions and cooperation. Much appreciation is expressed to the sponsors. Without initial financial support from the Ministry of Education and the Eindhoven University of Technology we could not have started the organization.

Organizing a conference is a lot of work, but we received often unexpected support. Without trying to be exhaustive, we want to acknowledge warmly Annelies Vincent for her decision to appoint Oda Weyers in the period that Marja Brand was unable to fulfill her task; Tineke Tolsma for her expert assistance in all kinds of secretarial jobs; Fabiola Bukkems for her contributions to the financial part of the organization; and last but not least there was Leo Balmer: we owe him special acknowledgement for his invaluable contribution to the smooth running of the conference.

Marijke van Vonderen
Oda Weyers

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INTRODUCTION

The GASAT (Gender and Science and Technology) Association is concerned with issues arising from interactions between gender and science and technology. Its objectives are:

- ▶ to encourage research into all aspects of gender differentiation in science and technology education and employment;
- ▶ to foster gender equity in science and technology, in education and in the workplace;
- ▶ to facilitate the entry of women into employment in the fields of science and technology, and their progress within such employment;
- ▶ to foster socially responsible and gender-inclusive science and technology;
- ▶ to provide a forum for dissemination and discussion of research findings and experiences of those working in the field;
- ▶ to provide a support network for those working towards the objectives outlined above.

In the past twelve years every two years a GASAT conference has been organized and encouraged worldwide participation. In between three times a European GASAT was held: in Denmark (1986), in Sweden (1990) and in 1992 by the women's groups of the Eindhoven University of Technology in The Netherlands.

This book is the third volume of an edited series associated with the third European GASAT conference, held in the Golden Tulip Hotel at Geldrop, The Netherlands, in October 1992. Volumes I en II, published prior to the conference, contain the conference contributions. This volume contains the proceedings.

The theme of the conference was *Ten years GASAT activities in a changing Europe* and we called for contributions from Western European researchers and from Eastern colleagues as well.

Following the tradition of GASAT-conferences, papers formally accepted as contributions to the conference, were distributed in advance. The two volumes were posted to all participants except those living in Eastern Europe since we expected a postage delay to Eastern European countries. Unfortunately many participants received the books just a few days before the conference, because much time was lost between delivery and postage of the books. At the start of the conference, however, all participants were in the possession of Volumes I and II of the Contributions.

THE PARTICIPANTS

The conference was attended by 87 participants from 19 countries. Of these 74 people attended for all or almost all days and 11 people attended the Visitors' Day on Monday 26 October and two visitors participated on Tuesday 27 October 1992.

We were granted financial support to cover expenditures of twelve researchers from Eastern Europe. Although for two of them the guarantee of financial assistance came too late to get their visa in time, with help from others there were 12 colleagues from Mid and Eastern Europe at the conference indeed.

The conference language was English. This might have been a barrier for colleagues from France and Spain to participate. On the other hand, the last week of October was a problem for University-people from countries where the Academic year just had started. Neither the language nor the date stopped 87 people to come to Geldrop near Eindhoven and we were very happy to welcome them on Sunday afternoon October 25th, 1992, before dinner.

PROGRAMME GASAT CONFERENCE 25-29 OCTOBER 1992

Eindhoven University of Technology

Sunday October 25 th	Monday October 26 th	Tuesday October 27 th	Wednesday October 28 th	Thursday October 29 th
	<i>visitors day</i>		<i>university day</i>	
	breakfast	breakfast	breakfast	breakfast
	07.00	08.30	09.00	09.00
	briefing	briefing	briefing	briefing
	papers: share & discuss 1.1 2 3	papers: share & discuss 11.7 8 9	university speech keynote 3	homegroup reflect and evaluate
13.00-16.00	coffee break	coffee break	coffee break	coffee break
	papers: share & discuss 1.4 5 6	papers: share & discuss 11.10 11 12	keynote 4	plenary reporting of the
registration			reception & lunch	homegroups
	12.00	12.30	14.00	farewell lunch
briefing	lunch & displays	lunch & displays	excursion	
	keynote 1	Forum "East and West"	house of the future	
	15.00	15.00	16.00	
	tea in home group	tea in home group	posters p1 p2 p3 p4 p5	
opening	workshops w1 w2 w3	workshops w1 w2 w3	free	
dinner	free	dinner	university reception	
	17.00	18.00	19.30	
	dinner	free	concert dinner	
keynote 1	workshops w5 w6 w7	workshops w9 w10 w11 w12		
meeting your homegroup	free	free		
	21.00			

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- Keynotes: 1 Jacquelyne Eccles
 2 Else Barth
 3 Jan Harding
 4 Elin Kvande

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THE PROGRAMME

On Sunday afternoon the conference was opened by Ilja Mottier, chair of the Interim Board of the GASAT Association. The programme included a number of activities: keynote addresses and the East-West Forum, papersessions, poster presentations, workshops and round tables, an excursion to the House of the Future, and home group meetings. A copy of the overview of the programme is included.

The plenary sessions

On Sunday Ilja Mottier's opening address was followed by dinner and after that Jacquelynne Eccles (Professor of Psychology, University of Michigan, Ann Arbor, U.S.A.) read the first keynote lecture on *Bringing young women to math and science*. After a short discussion the participants split up in their home groups for further discussion and evaluations.

Each morning of the conference, after breakfast all participants convened for a briefing about conference organization.

On Monday, 2 pm, the second keynote address was read by Else Barth (Professor of Logic and Analytic Philosophy, Groningen University, The Netherlands) and the title of her lecture was *Turning the tables. Counteracting the effects of male anxieties: a study of the sexual origins of early human logic*. This lecture elicited many comments and discussion in the home groups afterwards.

On Tuesday in stead of Dimitrina Petrova's keynote lecture on *The relative incompatibility of the gender, science, technology problem field in Western and Eastern European cultures* the East-West Forum took place. In the week before the conference Dimitrina Petrova's office had been visited by intruders who ruined office equipment and some of her recent work. The aftermath of police and insurance made it impossible for her to come. The Forum was chaired by Dora Dolle-Willemsen (The Netherlands);

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participants were: Seçkin Ergin (Turkey), Petya Kabakchieva (Bulgaria), Tatiana Koke (Latvia), Vitalina Koval (Russia), Olga Plávková (Czech and Slovak Federal Republic), Adela Rogojinaru and Mihaela Singer (Romania), Hanna Ziajka (Poland), and Valentina Zlenko (Ukraine). They all shared in short their view on women in science and technology in their country. The audience learned a lot and many were disappointed that time was too short to start a more thorough discussion of the problems.

Wednesday morning all conference participants moved to the Eindhoven University of Technology where they were welcomed by the Rector Magnificus Professor Jack van Lint. After his speech Jan Harding (Equal Opportunities Consultant, and Member of the Interim GASAT Board, Alresford, Hampshire, UK) read her keynote lecture on *A decade of concern: the GASAT experience*. A lively discussion was followed by a short coffee break and after that Elin Kvande (Associate Professor, Institute of Sociology, University of Trondheim, Norway) read her lecture on *The gender politics of organisations. A study of male and female engineers*. Both lectures were also of interest to the university staff of whom about 20 had taken the opportunity to attend this part of the conference.

In the afternoon an excursion was made by bus to the House of the Future. This excursion was introduced by two papers from Marion Menten and Annemarie van de Vusse (Delft University of Technology, The Netherlands). A reception by the Board of the Eindhoven University of Technology concluded the day at the university. Back at the Hotel all participants made their last preparations for the concert dinner. Another GASAT tradition followed and during dinner each country was represented with an act, perfectly introduced and chaired by AnnMarie Israelsson. This time all acts were evaluated by a committee of women from Norway and Sweden. And, remarkably, all points given to the acts of each country mounted allways up to ten!

On Thursday morning a last plenary session was dedicated to a presentation of the evaluation of the conference by representatives of the home groups.

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Papers: share and discuss

The subjects of the papersessions were organized according to the contents of the 43 accepted formal papers. There were four main themes:

1. Education and Schooling,
2. Employment,
3. Research Methodology and Evaluation Research
4. Joint European Projects.

Papersessions were held on Monday and Tuesday morning before and after a coffee break in three parallel meetings. In each meeting three or four papers were summarized. Chairpersons then led a discussion with authors on questions which arose from the floor.

Workshops and round tables

On Monday afternoon and on Monday and Tuesday after dinner workshops were organized. These sessions were highly interactive. Summaries of these sessions are included in this volume.

Posters and other displays

During the conference, a number of posters, books, brochures and folders, were on display in one of the rooms. On Tuesday afternoon time was organized to discuss these presentations with the authors.

Home groups

Each participant at the conference was allocated to a Home Group containing a mix of 8-10 people from as wide a range of countries as possible. As in Denmark and Australia the major purpose of the Home Group was to provide an intimate, more personal setting for interaction, reflection and discussion. Home Group meetings were planned each day, except University Day (Wednesday), after the keynote address of that day. A report of the Home Group activities is included in this volume.

CONCLUSION

One of the main objectives of the conference was to create an opportunity to discuss changes in Europe as a whole. We are very satisfied to conclude that we learned a lot about developments which threaten full participation of girls and women in science and technology, in different countries and cultures, and the different ways in which people cope with these developments. During the conference we learned:

1. GASAT is the abbreviation of Gender And Science And Technology. In English 'science' is equivalent to natural sciences, but this is not a matter of course in Eastern European translation. In particular in Slavic languages all university disciplines belong to 'science'; sometimes the impression existed that social sciences are even more 'science' than natural sciences.
2. The concept of technology did not cause definitional problems: it refers all over Europe to applied natural sciences and is studied in tertiary education (professional Colleges and Universities). However, being an engineer does not give the same social status in all countries. As an engineer one can get well paid and prestigious jobs in Western Europe: the problem is here that few women profit from this situation on the labourmarket. On the contrary in Russia and Bulgaria, for instance, there are many female engineers but they are doing low prestigious work, often too dirty to be done by men.
3. In Western Europe the choice process for higher education is different from that in former socialist countries in Europe; academic choices of girls and boys are considered as investments for the future and in the West highly influenced by sex differences in life perspectives at school-age. Eastern European students are used to continue education in disciplines they are good at; differences in life perspectives probably are not considered at the moment academic choices are made, or not in the same way as it happens in Western Europe. Therefore more contributions from Eastern Europe focus on sex differences in employment than on these differences in educational choices.

OPENING ADDRESS
&
KEYNOTES

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OPENING ADDRESS

Ilja Mottier
Interim Chair of the GASAT Association

Dear colleagues,

I welcome you all to this third European GASAT conference, which all together is the ninth GASAT where we meet. I especially would like to do so on behalf of the board of the GASAT association.

For some of us, this day is one of meeting old friends, others among you are quite new and have to find their way in the group.

Today, at the point of starting a week of intense discussions and of exchange of experiences, we ask ourselves: where do we stand at this moment, and where are we going to. In which sense this conference can help us to go where we intend to go. Or in which sense this conference will teach us that we have to go into another direction, that our expectations are too high, or just not realistic.

I am not going to dress the history of GASAT. Dr. Jan Harding will deal extensively one of these days with all that has been done under the GASAT umbrella.

Objectives of GASAT

Some of you may be aware of the fact that we have founded a GASAT association. The objectives of this association have been formulated on the basis of what we have done in the past. It is therefore good to bring them to the minds of all present.

The objectives of the GASAT association are:

- * To encourage research into all aspects of gender differentiation in science and technology education and employment
- * To foster gender equity in science and technology, in education and

- in the workplace
- * To facilitate the entry of women into employment in the fields of science and technology and their progress within such employment
 - * To foster socially-responsible and gender-inclusive science and technology
 - * To provide a forum for dissemination and discussion of research findings and experiences of those working in the field
 - * To provide a support network for those working towards the objectives outlined above.

These objectives contain all the issues that people may feel important. For some it is the issue of the masculine character of science and technology. For others it is the few number of (young) women in the scientific studies and professions. Others are concerned about ethical questions in the research.

We do not all share the same opinions about everything. We may approach things differently, may have a different perception about whether things have to be defined as a 'problem' or not. But there is one thing that we share and that we want to preserve: that is a critical mind.

The gender perspective

We come to GASAT conferences because we do not take all things for granted, because we want to reflect on common practices, because we want to operate in a spirit of innovation and renewal.

This, we believe, should be the state of mind of every teacher, every researcher, every policy maker, every worker, of every citizen.

We are not advocating criticism for its own sake. But we believe that every professional, every intellectual in the field we are working in, must constantly examine their own practices. This is the duty of a professional, it is the duty of us who have had the privilege of advanced education, which enables us to reflect on what we see around us.

The perspective from which we start our analysis is a gender perspective. This means that in analysing situations we encounter, we ask ourselves what place masculinity and femininity occupy in that situation. Which - overt or covert- conceptions of masculinity play a role. How does this affect men and women?

We may analyse how the discourse about nature uses female expressions. And how the violence towards nature by means of technology is phrased in the imagery of violence towards the female.

We may study the participation of young women in science and technology education, and see that in many countries this participation lags behind that of young men. What are the reasons and how can we change it? Do we want to change it?

What image does the public have of a 'typical scientist' and his (because it is a man!) character, and how does this affect men?

Or how can we get more women in economically attractive technical jobs, and have them stay there?

What do we know about the history of women in science?

All these are examples of questions to deal with when studying the gender perspective in science and technology. And they have been discussed during GASAT conferences. Our aim is at least a better understanding of phenomena we see around us.

We can say research ends here. But for most of us, gender studies have emancipatory potential: when we encounter situations we esteem undesirable, we want to change them. To the benefit of women, or to the benefit of men, depending of who is touched by the prejudice.

Women in science and technology: the situation

This is more or less how we have been looking at gender studies during GASAT conferences. But 'we' is not an easy term. Who is 'we' at conferences with a worldwide character. Is every researcher in the whole world looking at problems of gender and science and technology in the same way?

Of course not. And this is at the same time a challenge and a risk. GASAT issues started in the Western world, with people who thought more or less the same. Now that GASAT is spreading, we see different opinions coming into the conference. This is something we have to be aware of, we have to find a way to deal with it, and we have to ask ourselves in which way we want to reorient GASAT objectives, if necessary, and in which way not.

I would like to illustrate this point by looking at the issue that made us start GASAT: the low participation of young women in science and technology. A whole series of researches has been carried out into possible reasons. Within the girls: their interest, their performance, their spatial ability, their manual skills, their career perspectives, their peer group behaviour, everything has been investigated. The same can be said for the within-school processes: the masculine content of the curriculum, the language of the schoolbooks, the interaction in the classroom, the counsellor's behaviour, the teacher's expectations.

The low participation was seen as a widespread phenomenon. Ten years ago, it seemed a universal concern. We see more nuances now.

Let us make some geographical excursions.

Almost all of the above mentioned themes have been researched in Anglo-saxon countries: the USA, Australia, Canada, Great Britain, and we may add countries like the Netherlands, Germany, Scandinavia. To give an example of the low participation of women in science: in the Netherlands in pre-university schools we have in 1990 29% of girls choosing physics, and 62% of boys. In shorter types of schools (mavo) the percentage for girls is 18%.

From countries in Southern Europe, we get different messages. Many colleagues will tell you there is no problem for women in science in, let us say, France or Portugal. And indeed, if we look at the statistics, we see in Portugal up to 67% of girls in natural sciences at secondary level, and 33% of boys. In France: section mathematics and physics: 50% girls, 50% boys;

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technician's certificate: 29% girls, 71 % boys. Which seems a good statistic, compared to most other European countries. In higher education the Southern European countries score relatively high too:

engineering enrolment of young women:
Greece 17%, Portugal 24%, France 16%.

In contrast:

Netherlands 9%, UK 8%, Ireland 6%, Germany 7%.

(Statistics compiled by Eurydice in 1990).

The situation in developing countries is unclear. In some, the position of girls lags behind the boys, in others the position of youngsters in education seems less determined by sex than by overall lack of financial means. The picture is more complex than this, because of course we cannot treat the major part of the world in one sentence as 'developing' countries. We have to make a closer analysis of the social and cultural contexts of parts of the world, if we want to come to an understanding of the position of women in science. The position of young women in Asia is not the same as in Muslim education, and even within Muslim states the situation is different. And although we are dealing with these issues at GASAT conferences, we still cannot say we have a clear picture of the position of women in science and technology - studies and occupations - throughout the whole world.

And Eastern Europe?

There seems not to be a problem with women in science and technology in Eastern Europe. There are lots of women studying science and technology and working in scientific and technical jobs. The actual contributions to this conference do not seem to contradict this image.

For a closer look we should have to take country per country, but it is not probable that this would change our entire thinking.

Women in science and technology: the questions

I tried to make a rapid geographical tour with you and to present issues in a rather 'neutral' way.

Now let me come back to what I said in the beginning about the critical potential of gender studies. Gender studies, I said, means that in analysing situations, we ask ourselves what place masculinity and femininity occupy in that situation. Which - overt or covert- conceptions of masculinity play a role. How does this affect men and women?

With this in mind, let us go back to our geographical tour and see where we stand now with our knowledge and understanding.

In the Anglo-saxon countries a lot of gender analysis has been applied. We have analysed the discourse and interaction in the classrooms, the content of the curriculum. We dealt with learning styles. We made single sex classes. We had vocational training for young women and re-entry women.

What were the results: a slight increase of women in science and technology, the critical ratio for women in technology being at the best at 30%. Feeble breaches in the labour market.

A lot of mass media campaigns. Lipservice from employers in case of labour market shortages. And the uneasy feeling among many women: are we still used- again- to fill the gaps in the labour market, and are we sent home when we are not needed any more. Are we using the right instruments, and addressing the right target group at the right moment: must we focus on getting as many women as possible in technology, or must we concentrate on those who have already an interest, and prevent them from dropping out? Are we not starting too late when we address the sixteen year olds? Should we not all be teaching technology to the ten year olds? Must we really adapt our curriculum to the needs of girls? And then we look at Eastern Europe and say to ourselves: this was probably not done in Russia, and yet women studied science. How did they do it?

We try to change things in education, but see that the society around us is not changing at the same pace.

Well, you see, not an optimistic evaluation, and quite a research program.

Now some critical remarks about Southern Europe. The situation there, I confess, is something I still have not grasped completely. Many people will tell you there is no problem for women in science in Southern Europe. And I have given you some statistics who corroborate this allegation. Colleagues from there will tell you that there is no problem for women in the schools, that it comes in the labour market.

Yet I also see projects and materials being developed the same way as it is done in Great Britain or Germany. France has a large campaign to get young women into technology. In Spain booklets are made about women and science, women and computers.

With the GASAT conference we do not succeed in attracting many colleagues from Southern countries, who could clarify these issues for us. Is this only because of the language, or is there really no problem for women in science?

At our GASAT conference in Sweden developing countries were high on our agenda. And we are attracting, especially at the world conference, more and more colleagues from these countries.

This should bring elements in our conferences which are hitherto too little discussed. Questions of race and ethnicity: do they play a role in science education which is specific for science? Do ideas about femininity influence the options for girls? Does single sex education in Muslim countries foster science and technology for girls? Are black girls in technology double-discriminated?

And, more optimistic question: what use can science education make from the native knowledge about nature in less developed countries.

A necessary question too: can women with science education play a role in the society themselves, or is all public life, included educational policy and labour market policy, governed by men?

I finally come to some questions concerning Eastern Europe.

In the Eastern European countries, there are lots of women in science and technology, as there are in the technical professions. What was the determining factor that made those women go? In the West we look at it and try to imagine factors from which we could learn.

The social context: all citizens were supposed to work outside the home, work was not considered as a 'hobby' for women. Children have working mothers.

The school: a female teaching staff, therefore role models in science.

Contacts between schools and the working place, few contacts outside the country: accent on science and technology, less on modern languages.

Subjects girls in the West are traditionally good at.

These are some of the factors that we think can contribute to women's choice of science. They were fulfilled in the Eastern countries. Did they make the difference?

More than ten years of gender studies make one suspicious in many respects, and we in GASAT are. So other questions come up as well: what is the status of science, of technology in society?

Is there a free choice of study, or is there a planned entrance to higher education.

What are the men choosing?

How is the position of women in science and technology developing since the opening towards the West. How is women's employment developing?

Answers to these questions might throw different light on the position of women in science and technology.

But one thing is sure: the women *did* study science and technology. Apparently no lack of spatial ability. No lack of logical reasoning. No lack of selfconfidence, no negative advice from teachers. Are your genes different from ours, or how did you do it?

I think it is worth studying those questions, in order to see if they can provide us with insight.

4:10

And to the women from the East I would like to ask: why do you come to a GASAT conference? How do you think you can benefit from it?

When I read your contributions to the conference, there is one remark that comes to my mind: learn to be suspicious when the position of women is at stake. Never take things for granted. If it is said: this measure, this act, is good for women, check whether it is true, keep following the outcomes.

If a new curriculum is proposed, analyse if it contains topics of interest for both women and men. This means: topics for women and men together, topics for men, topics for women. And this all in the same curriculum.

Remember we are in GASAT not talking about gender-neutral science, but about *gender-inclusive* science.

If a new course of study is proposed, does it lead for women to solid job perspectives?

Are men given any education about what it means to be a working person and to have a family?

We hope a mutual exchange will take place: from the West to the East about the inclusion of the gender perspective in your work, from the East to the West the insight about what in your systems worked for women.

Dear colleagues,

You are starting a conference where you want to discuss lots of things.

Questions in your own papers you sent us months ago. And now I come up with new questions! I nevertheless thought it better to do it now than at the end of the conference. May be you can think it over.

I have in the past minutes started by remembering the objectives of GASAT. I stressed that GASAT is an association which analyses problems from the point of view of gender, that we remain critical, and that we want to use our insight to change the position of either sex when we see that groups are discriminated on the basis of sex, and, I add, of race and ethnicity.

I then made a brief tour around the world describing the position of women in science and technology. In doing so, I showed that in spite of libraries full of research, there is still a lot, in every place in the world, that

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we don't know. Putting all our uncertainties together would show us possible research programs. The worldwide position of women has become too complex to be phrased in one uniform analysis. But still, we can use this conference to meet each other and to gain a better understanding of the social contexts we live in and how this shapes our lives in science and technology.

I wish you a good conference.

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PSYCHOLOGICAL AND SOCIAL BARRIERS TO WOMEN'S PARTICIPATION IN MATHEMATICS AND PHYSICAL SCIENCE

Jacquelynne Eccles
University of Michigan

Abstract

Despite recent efforts in the United States to increase the participation of women in advanced educational training and professional fields linked to applied mathematics and technology, women are still underrepresented in these fields of study and work. This is even true among women gifted in mathematics. Why? Many possible causes have been proposed by interested researchers. This paper focuses on a set of social and psychological factors that my colleagues and I have been studying for the last 20 years. It begins with a brief review of the gender differences in educational and occupational choices among the gifted - focusing particularly on math-related fields. It then summarizes a model to account for these differences, reviews the available evidence to support the hypotheses generated by the model, discusses the role that socialization agents may play in perpetuating these gender differences.

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Despite recent efforts in the United States to increase the participation of women in advanced educational training and professional fields linked to applied mathematics and technology, women are still underrepresented in these fields of study and work. This is even true among women gifted in mathematics. Why? Many possible causes have been proposed by interested researchers. Discussing all of these is beyond the scope of a single talk. So today I'll focus on the set of social and psychological factors that my colleagues and I have been studying for the last 20 years. I'll begin with a brief review of the gender differences in these patterns among the gifted. I will then summarize a model to account for these differences, review the available evidence to support the hypotheses generated by the model, discuss the role of socialization agents may be playing in perpetuating these gender differences. I will focus in particular on recent findings regarding the under representation of gifted women in maths and physical science. The fact that gifted women are underrepresented in these fields is especially worrisome since these women clearly have sufficient intellectual talent to participate as fully as their male peers in these educational and vocational settings.

Gender Differences in Educational and Occupational Patterns

In reviewing the educational and occupational patterns of gifted men and women, I have relied heavily on two sets of data: the longitudinal data compiled on Terman's gifted population and the cross-sectional and longitudinal data being compiled by researchers associated with the Study of Mathematically Precocious Youth originally based at Johns Hopkins University.

Terman's Gifted Population

In 1921, Terman began a longitudinal study of approximately 1,450 gifted boys and girls 7 to 15 years old. The original sample contained 831 males and 613 females. These individuals have been recontacted several times; extensive demographic, intellectual, and social-developmental data were gathered at each contact. Because the researchers have been able to relocate approximately 80 percent of the original sample at each new wave of data collection, this longitudinal study provides the richest and most complete set of data available on the life-span development of gifted males and females. Although bound by its historical period, it provides the best data available for comparing the educational and occupational patterns of gifted males and females.

Gender differences in the educational and educational patterns of Terman's sample first emerged when the sample was in college. These women and men chose very different fields at both the graduate and undergraduate level (Terman & Oden, 1947), in particular, with relation to physical science and engineering: The men were 8-15 times more likely than the women to earn degrees in engineering; similarly the men were 3 times more likely than the women to earn degrees

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in physical science. In contrast, the women were 3-9 more likely than the men to earn degrees in education and the humanities. There were also substantial differences in the amount of education obtained by the females and males in this study. While the men and women were equally likely to earn their bachelor's degree, the men were more likely than the women to complete graduate degrees.

Differences in occupational patterns are even more extreme (Oden, 1968). The most striking difference lies in the proportion of men and women who reported having an occupation: only 42% of the women were employed during most of their adult years compared to 96% of the men. These women and men also tended to be employed in gender-role stereotypic jobs. The women were especially likely to be underrepresented in high status jobs of all kinds, and in the fields of science and engineering (less than 1% of the women compared to 15% of the men. In contrast, they were over represented in the fields of precollege teaching (27% versus 4% of the males), and social welfare (6% compared to 0%). Clearly these gifted women were greatly underrepresented in the fields of math and physical science despite their exceptional talent.

Johns Hopkins Study of the Gifted

Over the past 20 years, Julian Stanley and his colleagues at Johns Hopkins University have been studying mathematically and verbally precocious children. During this period, several thousand junior high school-aged children drawn from regional and national talent searches have been given aptitude tests and questionnaires tapping attitudes, career plans, interests, and values. Many of these children have been or are currently being retested in order to chart their educational development.

Perhaps the most interesting aspect of the data emerging from these studies is their similarity to the findings of the Terman studies, especially given the social changes that have occurred during the last 50 years. Just as was true in the Terman study, fewer females than males have emerged as gifted in mathematics in each of the Johns Hopkins studies (Benbow & Stanley, 1982, 1983). Furthermore, the boys in the Johns Hopkins samples have consistently scored higher than the females on the SAT-Math test (the test used by the Johns Hopkins team to assess mathematical talent) (Benbow & Stanley, 1982, 1983). Finally, the girls have scored as well as the boys on the SAT-Verbal test (the test used to assess verbal talent). Thus, as was true of the Terman sample, giftedness in math is more common and more extreme among boys. In contrast, verbal precocity appears more equally distributed between the sexes (Fox & Cohn, 1980).

The pattern of gender differences in educational pursuits is also quite similar across the two studies despite the lapse of 50 years. In fact, differences that were not apparent until college in the Terman sample are evident in the Johns Hopkins samples by junior high school. This difference is best characterized in terms of the under representation of girls in "extra" educational settings.

especially settings associated with math and science. The Johns Hopkins teams have consistently found that gifted girls were less likely than gifted boys to be enrolled in accelerated and/or special math and science programs (Benbow and Stanley, 1982; Stanley, 1976), to respond positively to an invitation to join a gifted math and science program (George and Denham, 1976; Stanley, 1976), and to enter college early (Stanley, 1976). In addition, in follow-ups of the boys and girls who enrolled in the Johns Hopkins Summer Enrichment courses, the girls were less likely to remain on an accelerated math track (Fox and Cohn, 1980), enrolled in fewer physics courses (Benbow and Stanley, 1982; Benbow and Minor, 1986), were less likely to take AP courses in the sciences and less likely to take advanced placement exams or college board achievement tests in chemistry and physics (Benbow and Minor, 1986), expressed less interest in majoring in science or engineering in college than the boys (Benbow and Stanley, 1984) and reported liking physics and chemistry less in high school (Benbow and Minor, 1986), and finally were significantly less likely to major in the physical sciences and engineering in college, to seek post graduate training in physics, computer science, and engineering, and to aspire to a career in physical science and engineering, particularly a research career in these fields (Benbow, 1988). These difference exist despite the fact that these girls, like the girls in the Terman study, did just as well as the boys in their high school math and science courses.

Conclusions

As is true for the population at large (Eccles, 1984), gifted females are less likely to study and to enter occupation related to applied mathematics, physical science and engineering. One might argue that the under representation of females in the sciences is a natural consequence of the pattern of gender differences on the aptitude measures taken by both Terman and the Johns Hopkins team. This is an unwarranted conclusion for several reasons. First, both of these studies focused on gifted children. Thus, even though the females may have had less math aptitude than their male peers, they certainly had sufficient aptitude to become important contributors to the scientific professions. The critical question was pointed out by Lila Braine in her response to Benbow's 1988 article in *Brain and Behavioral Science* - to quote "WHY ARE WOMEN VIRTUALLY ABSENT FROM FIELDS FOR WHICH THEY CLEARLY HAVE THE REQUISITE MATH SKILLS?" Second, while aptitude differences were positively related to the subsequent mathematical training of gifted boys in the Johns Hopkins programs, aptitudinal differences were unrelated to the gifted girls' decisions regarding both enrollment in subsequent accelerated math classes (Fox and Cohn, 1980) and intended college major (Benbow and Stanley, 1984). Furthermore, the gender differences in high school physics enrollment and in intended college major were significant even with the differences in math aptitude controlled (Benbow and Stanley, 1982, 1984; Benbow and Minor, 1986; Benbow, 1988).

Given these concerns, it is quite likely that social forces and personal beliefs play a significant role in perpetuating these gender differences in the educational and vocational patterns of gifted individuals. And, although institutional barriers and discriminatory practices undoubtedly account for some of the differences, psychological and social developmental processes are also important (see Eccles, 1984; Eccles and Hoffman, 1984). These processes are the focus of the remainder of this talk. Neither the potential causal impact of aptitudinal differences on male and female achievement patterns nor the possible causes of gender differences in performance on aptitude tests will be discussed.

Psychological Influences on Educational and Vocational Choices

In particular I will focus on a general model of achievement-related choices developed by my colleagues and I over the past several years (Eccles, Adler, Futterman, Goff, Kaczala, Meece, and Midgley, 1983 and Meece et al., 1982). Given the importance attached to gender role by many investigators in this field (e.g. Fox and Cohn, 1980; Nash, 1979), special attention will be paid to the ways in which gender-role socialization may be affecting gifted individuals' educational and occupational decisions.

A Model of Achievement-Related Choices

Over the past 20 years, my colleagues and I have studied the motivational and social factors influencing such long and short range achievement goals and behaviors as career aspirations, vocational and avocational choices, course selections, persistence on difficult tasks, and the allocation of effort across various achievement-related activities. Given the striking differences in the educational and vocational patterns of intellectually able, as well as gifted, males and females, we have been particularly interested in the motivational factors underlying males' and females' educational and vocational decisions. Frustrated with the number of seemingly disconnected theories proliferating to explain gender differences in these achievement patterns, we developed a comprehensive theoretical framework to guide our research endeavor. Drawing upon the theoretical and empirical work associated with decision-making, achievement theory, and attribution theory (see Atkinson, 1964, Crandall, 1969, and Weiner, 1974), we have elaborated a model of achievement-related choices. This model, depicted in Figure 1, links educational, vocational, and other achievement-related choices most directly to two sets of beliefs: the individual's expectations for success and the importance or value the individual attaches to the various options perceived by the individual as available. The model also specifies the relation of these beliefs to cultural norms, experiences, aptitudes, and to those personal beliefs and attitudes that are commonly assumed to be associated with achievement-related activities by researchers in this field (Eccles et al., 1983). In particular, the model links achievement-related beliefs, outcomes,

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and goals to causal attributional patterns, to the input of socializers (primarily parents and teachers), to gender-role beliefs, to self perceptions and self concept, and to one's perceptions of the task itself. Each of these factors are assumed to influence both the expectations one holds for future success at the various achievement-related options and the subjective value one attaches to these various options. These expectations and the value attached to the various options, in turn, are assumed to influence choice among these options.

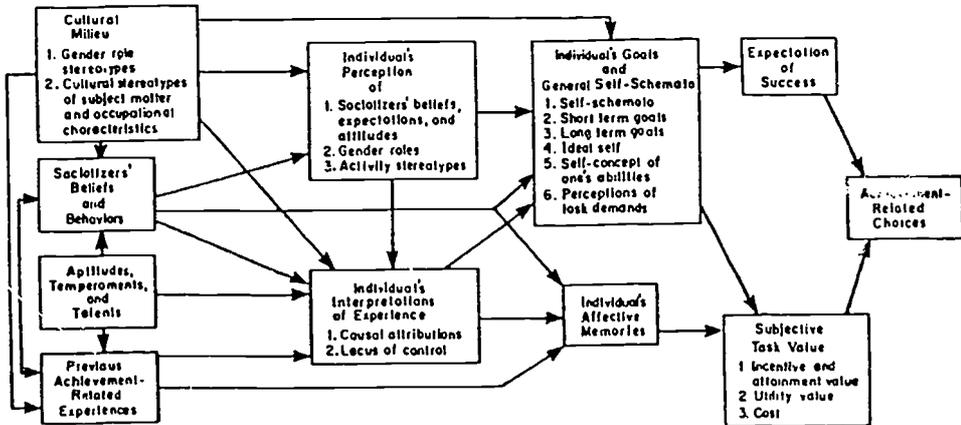


Figure 1. General model of achievement and activity choice.

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For example, let us consider course enrollment decisions. The model predicts that people will be most likely to enroll in courses that they think they will do well in and that have high task value for them. Expectations for success depend on the confidence the individual has in his/her intellectual abilities and on the individual's estimations of the difficulty of the course. These beliefs have been shaped over time by the individual's experiences with the subject matter and by the individual's subjective interpretation of those experiences (e.g. does the person think that her/his successes are a consequence of high ability or lots of hard work?). The value of a particular course is also influenced by several factors including the following: Does the person like doing the subject material?; Is the course required?; Is the course seen as instrumental in meeting one of the individual's long or short range goals?; Have the individual's parents or counselors insisted that the course be taken or, conversely, have other people tried to discourage the individual from taking the course?; Is the person afraid of the material to be covered in the course?

Three features of our model are particularly important for understanding gender differences in educational and vocational decisions: The first of these is our focus on achievement-related choices as the outcome of interest. We believe that individuals continually make choices, both consciously and nonconsciously, regarding how they will spend their time and their efforts. Many of the most significant gender differences in vocational aspirations and occupational choices, occur on achievement-related behaviors that involve the element of choice, even if the outcome of that choice is heavily influenced by socialization pressures and cultural norms. Conceptualizing gender differences in achievement patterns in terms of choice takes one beyond the question of "Why aren't women more like men?" to the question "Why do women and men make the choices they do?". Asking this latter question, in turn, legitimizes the choices both women and men make and suggests several new variables as possible mediators of the gender differences we observe in individuals' educational and occupational choices. By legitimizing the choices of both men and women, it allows us to look at the gender differences from a choice perspective rather than a deficit perspective.

Conceptualizing gender differences in achievement-related behaviors in terms of choice highlights a second important component of our perspective; namely, the issue of what becomes a part of an individual's field of possible choices. Although individuals do choose from among several options, they do not actively, or consciously, consider the full range of objectively available options in making their selections. Many options are never considered because the individual is unaware of their existence. Other options are not seriously considered because the individual has inaccurate information regarding either the option itself or the individual's possibility of achieving the option. For example, a girl may have inaccurate information regarding the full range of activities an engineer can do or inaccurate information regarding the financial assistance available for advanced educational training. Still other options may not be seriously considered because they

do not fit in well with the individual's gender-role schema. Assimilation of the culturally defined gender-role schema can have such a powerful effect on one's view of the world that activities classified as part of the opposite sex's role are rejected, often nonconsciously, without any serious evaluation or consideration.

Understanding the processes shaping individuals' perceptions of their field of viable options is essential to our understanding of the dynamics leading women and men to make such different occupational and educational decisions. Yet there is very little evidence regarding these processes and their link to important work choices. Socialization theory provides a rich source of hypotheses; few of which have been tested. For example, one effect of role models may be legitimizing novel and/or non-traditional gender-role options. Parents, teachers, and school counselors can also influence students' perceptions of their field of options through the information and experiences they provide the students regarding various options. Finally, peers can affect the options seriously considered by either providing or withholding support for various alternatives. These peer effects can be both quite direct (e.g. laughing at a girl when she says she is considering becoming a nuclear physicist), and very indirect (e.g. anticipation of one's future spouse's support for one's occupational commitments).

The third important feature of our perspective is the explicit assumption that achievement-related decisions, such as the decision to enroll in an accelerated math program or to major in education rather than engineering, are made within the context of a complex social reality that presents each individual with a wide variety of choices; each of which has both long range and immediate consequences. Furthermore, the choice is often between two or more positive options or between two or more options that each have both positive and negative components. For example, the decision to enroll in a physics course is typically made in the context of other important decisions such as whether to take advanced English or a second foreign language, whether to take a course with one's best friend or not, whether it's more important to spend one's senior year working hard or having fun, etc. Too often theorists have focused attention on the reasons why capable women do not select the high status achievement options and have failed to ask why they select the options they do. This approach implicitly assumes that complex choices, such as career and course selection, are made in isolation of one another; for example, it is assumed that the decision to take advanced math is based primarily on variables related to math. We explicitly reject this assumption, arguing instead that it is essential to understand the psychological meaning of the roads taken as well as the roads not taken if we are to understand the dynamics leading to the differences in men's and women's achievement-related choice.

Consider, as an example, two gifted high school students: Mary and Barbara. Both young women enjoy mathematics and have always done very well. Both have been identified as gifted in mathematics and have been offered the opportunity to participate in an accelerated math program at

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the local college during the next school year. Barbara hopes to major in journalism when she gets to college and has also been offered the opportunity to work part time on the city newspaper doing odd jobs and some copy editing. Mary hopes to major in biology in college and plans a career as a research scientist. Taking the accelerated math course involves driving to and from the college. Since the course is scheduled for the last period of the day, it will take the last two periods of the day as well as 1 hour of after-school time to take the course. What will the young women do? It all likelihood, Mary will enroll in the program because she both likes math and thinks that the effort required to both take the class and master the material is worthwhile and important for her long range career goals. Barbara's decision is more complex. She may want to take the class but may also think that the time required is too costly, especially given her alternative opportunity at the city paper. Whether she takes the college course or not will depend a lot on the advice she gets at home and from her counselors. If they stress the importance of the math course then its subjective worth to her will increase. If its subjective worth increases sufficiently to outweigh its subjective cost, then Barbara will probably take the course despite its cost in time and effort.

In summary, we assume that achievement-related choices, are guided by the following: (a) one's expectations for success on the various options, (b) by the relation of the options both to one's short and long range goals and to one's core self identity and basic psychological needs, (c) by the individual's gender-role schema, and (d) by the potential cost of investing time in one activity rather than another. All of these psychological variables are influenced by one's experiences, by cultural norms, and by the behaviors and goals of one's socializers and peers. Let me now discuss each of these variables in more detail as they relate to the achievement-related decisions of gifted men and women. It should be noted, however, that although there are sound theoretical reasons for suggesting these links, in most cases the essential empirical work remains to be done.

Expectations for Success/Confidence in One's Ability

Expectations for success and confidence in one's abilities to succeed have long been recognized by decision and achievement theorists as important mediators of behavioral choice (e.g., Atkinson, 1964; Bandura, 1977; Lewin, 1938; Parsons, Ruble, Hodges, & Small, 1976; Weiner, 1974). There have been numerous studies demonstrating the link between expectations and a variety of achievement-related behaviors including educational and vocational choices among both average and gifted populations. For example, Hollinger (1983) documented a fairly strong relationship between gifted girls' confidence in their math abilities and their aspirations to enter math-related vocations such as engineering and computer science. Similarly, Terman (1926) found a positive relationship between gifted students' subject matter preferences and their ratings of the ease of the subject for themselves.

But do males and females differ in their expectations for success at various academic subjects and in various occupations? For the population at large, females from about age 10-12 report lower expectations for their performance and less confidence in their ability in mathematics than boys; females also score lower on measures of math efficacy than males (Betz & Hackett, 1981; Brush, 1980; Dweck & Licht, 1980; Nicholls, 1875; Eccles, 1989; Eccles et al., 1984) In addition, these differences in self-perception are one of the mediators of the gender differences in occupational decisions. The answers is less clear with regard to the gifted population. For example, on the one hand, Fox (1982) found that highly-motivated gifted girls have lower self-confidence than equally highly-motivated gifted boys; similarly, Terman (1926) found that gifted girls were more likely to underestimate their intellectual skills and knowledge while gifted boys were more likely to overestimate theirs. On the other hand, Tidwell (1980) found no gender differences on measures of general self-concept; similarly, both Tidwell (1980) and Tomlinson-Keasey and Smith-Winberry (1982) found no gender differences on measures of Locus of Control (a construct often linked to self confidence and personal efficacy beliefs; e.g. Bandura, 1977). There is also little evidence to support the hypothesis that gifted girls are less confident than gifted boys of their math and science ability. For example, Benbow and Stanley (1982) found no substantial gender difference in gifted students' estimates of their math and science competence; similarly, although the gifted students in his study did prefer courses that they thought were easier for them, the boys and girls in Terman's study (1926) did not differ in their perceptions of the ease of mathematics. Finally, Schunk and Lilly (1982) found gender difference in gifted children's expectations for success on a laboratory math task.

Given this mixed set of results, it is not clear that gifted girls are typically less confident of their intellectual abilities than are gifted boys. Although it is true that the differences, when they are found, do support this conclusion, the differences, even when they exist, are quite small. Furthermore, the mediating role of these differences in explaining the gender differences in educational and vocational choices has not been demonstrated. It is possible, however, that researchers have been assessing the wrong expectancies. Typically, the students are asked to report on their confidence about succeeding on an upcoming task or course. They are not asked how confident they are that they could succeed in particular professions or in particular advanced training programs. They are also not asked how much effort they think it will take to succeed in various professions or advanced training programs. It could be that gifted girls are less confident than gifted boys of their prospects for success in these more abstract, distant activities. It is also possible that gifted girls are as confident as gifted boys are in their ability to succeed but assume that it will take a lot more effort to succeed than their male peers assume it will take. As noted earlier, either of these beliefs could mediate a gender difference in the educational and vocational

decisions of gifted individuals, especially given the gender stereotyping of high status occupations. Clearly more research is needed before these hypotheses can be evaluated.

Values as Mediators of Achievement-Related Choices

Value is the second major component of our expectancy/value model of achievement-related choices. We predict that decisions regarding course enrollments, college majors, and occupational choice are influenced by the value individuals attach to the various achievement-related options they believe are available to them. Furthermore, subjective value is hypothesized to have at least as much influence as expectations for success on educational and vocational choices. Finally, given the probable impact of gender-role socialization on the variables assumed to be associated with subjective task value, gender differences in the subjective value of various achievement-related options are predicted to be important mediators of gender differences in achievement-related choices in both typical and gifted populations. Our own data support this hypothesis. In a longitudinal study of the math course enrollment decisions of high aptitude, college-bound students, gender differences in students' decisions to enroll in advanced mathematics were mediated primarily by gender differences in the value the students' attached to mathematics (Eccles, Adler, and Meece, 1984). More specifically, the girls were less likely than the boys to enroll in advanced mathematics primarily because they felt that math was less important, less useful, and less enjoyable than did the boys.

Since value means many things to different social scientists and since value has received so little systematic attention until recently, I would like to elaborate on our interpretation of value and its link to achievement-related choices before reviewing the empirical literature. Like others (e.g. Crandall, 1969; Crandall, Katkovsky, and Preston, 1962; Raynor, 1974; and Stein and Bailey, 1973), we assume that task value is a quality of the task that contributes to the increasing or declining probability that an individual will select it. We have defined this quality in terms of four components: (1) the utility value of the task in facilitating one's long range goals or in helping the individual obtain immediate or long range external rewards ; (2) intrinsic interest in the task; (3) attainment value or the value an activity has because engaging in it is consistent with one's self-image; and (4) the cost of engaging in the activity. The last two of these are especially important for any consideration of the impact of gender roles on the value people attach to various activity choices. So let me say a little bit more about each of these.

Attainment value. We conceptualize attainment value in terms of the needs and personal values that an activity fulfills. As they grow up individuals develop an image of who and what they are. This image is made up of many component parts including (a) conceptions of one's personality and capabilities, (b) long range goals and plans, (c) schema regarding the proper roles of men and women, (d) instrumental and terminal values (Rokeach, 1973), (e) motivational sets, (f) ideal

images of what one should be like; and (g) social scripts regarding proper behavior in a variety of situations. Those parts of an individual's self-image that are central or critical to self-definition should influence the value the individual attaches to various educational and vocational options; these differential values, in turn, should influence the individual's achievement-related choices (Eccles, Adler, and Meece, 1984; Markus, 1980; Parsons and Goff, 1980). For example, if helping other people is a central part of Individual B's image, then B should place higher value on "helping" occupations than on "non-helping" occupations.

Essentially, I am arguing that personal needs, self images, and values operate in ways that both reduce the probability of engaging in those activities or roles perceived as inconsistent with one's central values and increase the probability of engaging in roles or activities perceived as consistent with one's definition of self. More specifically, we believe that individuals perceive tasks in terms of certain characteristics that can be related to their needs and values. For example, a difficult task requiring great effort for mastery may be perceived as an achievement task; if it also involves pitting one's performance against others, it may be perceived as a competitive task. Other tasks may be perceived in terms of nurturance, power, or ascetic pleasure. Participating in a particular task will require the demonstration of the characteristics associated with the task. Whether this requirement is seen as an opportunity or a burden will depend on the individual's needs, motives, and personal values, and on the individual's desire to demonstrate these characteristics both to him/herself and to others. To the extent that females and males have different self-images, various activities will come to have different subjective value for females and males. And, to the extent that females and males place differential subjective value on various educational and vocational options, they should also differ in their educational and vocational choices. This hypotheses is discussed in more detail later.

Perceived Cost. The value of a task also depends on a set of beliefs that can best be characterized as the cost of participating in the activity. Cost is influenced by many factors, such as anticipated anxiety, fear of failure, and, of particular importance in the discussion of long term educational and vocational choices, the loss of time and energy for other activities. People have limited time and energy. They can not do everything they would like. They must choose among activities. To the extent that one loses time for Activity B by engaging in Activity A and to the extent that Activity B is high in one's hierarchy of importance, then the subjective cost of engaging in A increases. Alternatively, even if the attainment value of A is high, the value of engaging in A will be reduced to the extent that the attainment value of B is higher and to the extent that engaging in A jeopardizes the probability of successfully engaging in B.

Gender-Roles and Task Value

This analysis has a number of important implications for our understanding of gender differences in the educational and vocational choices of gifted, as well as more typical, individuals. Because socialization shapes individuals' goals and values, women and men should acquire different values and goals through the process of gender-role socialization. Through their potential impact on subjective task value, these gender differences in value structure can affect educational vocational choices in several ways.

For one, gender-role socialization could lead males and females to have different hierarchies of core personal values (such as their terminal and instrumental values, Rokeach, 1973). Consequently, tasks embodying various characteristics should have different subjective values for men and women. For example, both boys and girls stereotype mathematicians and scientists as loners who have little time for their families or friends because they work long hours in a laboratory on abstract problems that typically have limited immediate social implications (Boswell, 1979). If the analysis developed in the previous section is correct such a profession should hold little appeal to someone who rates social values high and thinks it is very important to devote time and energy to one's family. Because gifted females rate social values higher than gifted males (Fox and Denham, 1974), gifted females should be less likely to aspire to a career as a mathematician or scientist than gifted males.

Several studies provide support for the hypothesized link between personal values and achievement-related choices. Dunteman, Wisenbaker, and Taylor (1978) studied the link between personal values and selection of one's college major using a longitudinal, correlational design. They identified two sets of values both that predicted students' subsequent choice of major and differentiated the sexes: the first set (labeled thing-orientation) reflected an interest in manipulating objects and understanding the physical world; the second set (labeled person-orientation) reflected an interest in understanding human social interaction and a concern with helping people. Students who were high on thing-orientation and low on person-orientation were more likely than other students to select a math or a science major. Not surprisingly, females in their study were more likely than males to be person-oriented and to major in something other than math or science; in contrast, the males were more likely than the females both to be thing-oriented and to major in math and science.

Men and women could also differ in the density of their goals and values. There is some evidence suggesting that men are more likely than women to exhibit a single-minded devotion to one particular goal, especially their occupational goal. In contrast, women in both gifted and typical populations seem more likely than men to be involved in, and to value, competence in several activities simultaneously (Baruch, Barnett, and Rivers, 1983; Fox, Pasternak, and Peiser, 1976; Maines, 1983; McGinn, 1976; Terman and Oden, 1947). For example, in his study of

doctoral students in mathematics, Maines (1983) asked the students what they worried about. The men were most concerned about their professional status and about their mentors' estimates of their professional potential. In contrast, the women were most concerned about the impact of their graduate training on their families and their other interests; they felt that graduate training was taking too much time and energy away from other activities that they valued just as much as their graduate training. This discrepancy could reflect differing density patterns for the hierarchy of goals and personal values held by these men and women. That is, the women appeared to place high attainment value on several goals and activities; in contrast, the men appeared more likely to focus on one main goal: their professional development. If this is true then the psychological cost of engaging in their primary goal in terms of time and energy lost for other important goals would certainly be less for these men than for their female colleagues.

Gender role socialization could lead males and females to place different value on various long range goals and adult activities. The essence of gender roles (and of social roles in general) is that they define the activities that are central to the role. In other words, they define what one should do with one's life in order to be successful in that role. If success in one's gender role is a central component of one's identity, then activities that fulfill this role should have high value and activities which hamper efforts at successfully fulfilling one's gender role should have lower subjective value. Gender roles mandate different primary activities for men and women. Women in the United States are supposed to support their husbands' careers and raise their children; men are supposed to compete successfully in the occupational world in order to confirm their masculinity and to support their families. To the extent that a gifted woman has internalized this cultural definition of the female role, she should rank order the importance of various adult activities differently than her gifted male peers. In particular, she should rate the parenting and the spouse-support roles as more important than a professional career role and she should be more likely than her gifted male peers to resolve life's decisions in favor of these family roles. In contrast, gifted men, like men in general, should rate family and career roles as equally important. In fact, since they can fulfill their family role by having a successful career, gifted men, like men in general, should expect these two sets of roles to be compatible. Consequently, aspiring after a high status, time consuming career should not pose less of a conflict for gifted men and such careers should have high subjective value not only because of the rewards inherent in these occupations but also because they fulfill the male gender role mandate.

The analysis developed in this section suggests the differential involvement of women and men in math and science-related occupations may result, in part, from differences in their interest patterns and their personal values (for example, being thing-oriented versus being person-oriented). Furthermore, this analysis suggests that the differential involvement of women and men in high status, time-consuming occupations requiring long periods of pre-professional training may result,

in part, from differences in men's and women's psychological investments in their family roles versus their professional roles. These gender differences in psychological investment in family versus professional roles are assumed to result from a complex set of both psychological and sociological forces including the internalization of gender roles, the individual's assessment of what jobs and roles are realistically available, and both overt and subtle forms of discrimination operating in educational and occupational institutions. Consequently, women may choose to limit their investment in the professional role because they want to maximize their investment in their family roles or because they think that their opportunities in the professional role are restricted by discriminatory forces beyond their control, or both. Since in the United States careers in math and physical science are assumed to be very time consuming and inflexible, women with traditional gender-role identities may be reluctant to enter these fields because they believe the time demands are incompatible with the demands associated with raising a family.

An adequate test of these hypotheses requires not only the demonstration of a gender difference in interest patterns and value hierarchies; it also requires a demonstration of the proposed causal link between these beliefs and the educational and vocational choices gifted men and women make. By and large, these causal links have not been assessed in either gifted or more typical populations. Thus, as was true for expectations of success, the essential research has yet to be done. However, even though the causal relations implicit in this analysis have not been adequately studied, several large scale studies of the gifted have assessed gender differences in personal values and interests. In general the data are consistent with the analysis in this section. The details of these studies are outlined below.

Gender Differences in the Values and Interests of the Gifted

Both the Terman study and the SMYF studies have assessed interests, values, and goals on a large number of gifted individuals. These studies suggest that gifted boys and girls have different interests, values, and goals from an early age. Although gifted boys and girls appeared more similar in their values and interests than comparison groups of boys and girls drawn from the general population, the gifted girls in both studies had more stereotypically feminine interest patterns than the gifted boys. When asked their favorite school subjects the girls rated English, foreign languages, composition, music, and drama higher than the boys; in contrast the boys rated the physical sciences, physical training, U.S. history, and sometimes mathematics higher than the girls (Benbow and Stanley, 1984; George and Denham, 1976; Terman, 1926, 1930). The gender differences in interest in mathematics were typically quite weak if present at all. In contrast, the gender differences in interest in physics and applied mathematical fields like engineering are quite consistent and fairly large (Benbow and Minor, 1986, Benbow, 1988).

Similarly, when asked their occupational interests and/or anticipated college major, girls rated domestic, secretarial, artistic, biological science, and both medical and social service occupations and training higher than the boys while the boys expressed more interest than the girls in both higher-status and business-related occupations in general, and in the physical sciences, engineering, and the military in particular (Benbow and Stanley, 1984; Fox, Pasternak, and Peiser, 1976; Terman, 1926, 1930). Finally, when asked their leisure time activities and hobbies, similar differences in interest patterns emerged. At all ages, the females both liked and reported spending more time than the boys reading, writing, and participating in a variety of activities related to arts and crafts, domestic skills, and drama; in contrast, the males spend more time engaged in sports, working with machines and tools, and involved with scientific, math-related, and/or electronic hobbies (Fox, 1976; McGinn, 1976; Terman, 1926, 1930; Terman and Oden, 1947).

Gender-stereotypic patterns of differences also emerged on tests of personal values, occupational values, and personality traits. The Allport-Vernon-Lindsey Scale of Values was given to many of the children participating in the studies at Johns Hopkins. The gifted girls typically scored higher than the gifted boys on the scales tapping social and aesthetic values; in contrast, the boys typically scored higher than the girls on the scales tapping theoretical, economic, and political values (Fox, 1976; George and Denhan, 1976; McGinn, 1976). Similarly, on the Strong-Campbell Vocational Interest test, the girls scored higher than the boys on social and aesthetic interests. Both of the boys and girls, however, scored equally high (and quite high) on investigative interests (Fox, Pasternak, and Peiser, 1976; George and Denham, 1976; McGinn, 1976).

It is also of interest to note that the boys evidenced a more unidimensional set of interest than the girls on the Strong-Campbell Vocational Interest test; that is, the boys scored high on investigative interests and low on most other interests. In contrast, the girls scored higher than average on several interest clusters (McGinn, 1976). A similar discrepancy emerged when gifted boys and girls were asked to rate several occupations on a Semantic Differential Scale. The boys gave positive ratings only to traditional male scientific and mathematical professions; the female professions and homemaker role were rated negatively. In contrast, the girls gave both male and female typed professions a positive rating. In addition, they gave the homemaker role as positive a rating as their most preferred professional occupations; in contrast, the gifted boys responded rather negatively to the homemaker role.

A similar pattern emerged on the most recent data from the Terman sample (Sears, 1979). The gifted men and women were asked to rate how importance each of six goals were to them in making their life plans during early adulthood. Men rated only area (occupation) as having had higher importance than did the women; in contrast, the women rated four areas as having had higher importance than did the men (family, friends, richness of one's cultural life, and joy in living). These data suggest that the gifted women had desired a more varied or multi-faceted type of life

than the men had desired at precisely the time in one's life when people make the major decisions about their life plans. One other pattern characterized the responses of these gifted men and women: Consistent with our hypothesis, the men rated family and occupation as of equal importance while the women rated family as more important than occupation.

Summary. There are clear differences in the interests, values, and preferences between gifted males and females. Furthermore, these differences reflect gender-stereotyped patterns. These results are consistent with the analysis linking values to gender differences in educational and vocational choices. Additional support for this hypothesis comes from a recent report by Benbow and Stanley (1982). Gifted girls in their study were less likely than gifted boys to take advanced mathematics in part because they liked language-related courses more than they liked mathematics courses. In addition, Benbow and Stanley (1984) found weak but consistent positive relations in their gifted samples between liking of biology, chemistry, and physics and subsequent plans to major in biology, chemistry, and physics respectively. In addition, students' interest did predict course taking in high school and college (Benbow and Minor, 1986).

Parents, Teachers, and Counselors

Gender differences in educational and vocational choices could also result from differential socialization experiences. Several studies have documented the importance of social support from parents, teachers and counselors in lives of women who make non-traditional educational and occupational choices (Barnett and Baruch, 1978; Casserly, 1980). Perhaps gifted girls make rather traditional educational and occupation choices because they are not adequately encouraged to consider alternative choices. How might parents, teachers, and counselors affect gifted children's vocational and educational choices?

1. Through their power as role models. Male and female adults do different things and these differences in behavior provide a model of appropriate occupations for males and females.
2. Through their power as interpreters of experience. Social agents can influence children's self concepts, personal values, and preferences through the interpretations of experience that they provide.
3. Through their power as counselors. Social agents can influence children's view of the educational and vocational world through explicit and implicit messages they provide as they "counsel" children. Social agents, especially parents and school personnel, give children information about the occupational world and the need to prepare themselves for that world. Often these messages are gender-role biased. To the extent that this is true, boys and girls will internalize different views of the occupational world, different ideas about their potential involvement in that world, and different ideas regarding the need to be able to support oneself.

4. Through their power as reinforcers. Social agents can influence choices by the pattern of reinforcements they provide for engaging in various behaviors. Peer interaction is an excellent example of how the power of reinforcement could limit women's participation in math, engineering and physical science. Students often discuss the educational and occupational options they are considering with their friends; these discussions inform the students both of the opinions of their peers and of the likely reactions their peers will have to various options. As is true for other social agents, these opinions and reactions are often gender-role biased (see, for example, Frieze and Hanusa, 1984; Kavrell and Petersen, 1984). Since peer acceptance is so important during the adolescent years (Kavrell and Petersen, 1984), the gender-role bias in adolescents' reactions to each other's plans may limit the educational and vocational options considered seriously by gifted females at a time when very important achievement-related decisions are being made. Fear of peer disapproval could also lead gifted girls to either drop out of or refuse to participate in special programs for the gifted.

5. Through their power as shapers of experience. Social agents can influence the educational and vocational decisions of gifted individuals more directly by actively structuring the options that are offered to gifted boys and girls. For example, entry into accelerated or special programs depends on being identified as gifted by school personnel. To the extent that the process of identification is gender-biased, gifted girls and boys may differ in the opportunities they are offered to develop their skills; findings relevant to this prediction are discussed below. Parents can also either limit or broaden their children's educational and vocational options by the economic, as well as psychological, support they provide for various options. In the society at large, families with limited resources are more willing to invest these resources in their sons than in their daughters. If a similar preference characterizes families with gifted children, then gifted males should have more opportunities for special and advanced training than gifted females because their families are more willing to provide such opportunities. Such differences, if they exist, not only limit girls' options directly; they can also limit the development of gifted girls' preferences because they restrict the range of experiences gifted girls are exposed to.

Now let's look at the research related to these types of influence. I'll begin with noting that very little relevant information is available and what is available is quite limited in its scope and reliability. For example, some of the work claiming to show that gender differences among the gifted do not result from differences in boys and girls social experiences is based on a few self-report questionnaire items asking things like "Do you encourage your child to do well in math?" This type of question does not provide an adequate assessment of social experience.

Parents

In both the Terman and the Johns Hopkins studies, the parents of gifted boys and girls believed in their children's general intellectual talents. The child's gender, however, had more effect on the parents' estimates of their child's specific skills. For example, parents in Terman's study rated sons higher than daughters on math and mechanical ingenuity; they also rated daughters higher than sons on drama, music and general dexterity. Since this patterns of gender differences also characterized the children's performance on standardized skill tests, we can not determine the direction of causality for these data; the parents' estimates may have been a reflection of the differences they were observing in their children or the parents may have helped to create the behavioral differences through differential socialization practices (Terman, 1926). In our own study of gifted elementary school children (see Eccles & Harold, 1992), parents of gifted girls had most confidence in their child's ability in reading and instrumental music; in contrast, parents of gifted sons had most confidence in their child's math and sport ability. In addition, these parents provided gifted girls with more opportunity to develop their reading and instrumental skills while they provided their gifted sons with more opportunity to develop their interest and skill in sports. Interestingly, there were no gender differences on the aptitude measures we gave these children at the start of the study. Together these results suggest the parents of these gifted children were creating rather than reflecting gender differences in their children's aptitude.

Studies with more typical populations also suggest that the parents are creating gender differences in skill level, interest patterns, and self-perceptions through differential socialization (Eccles, 1992; Huston, 1983; Parsons, Adler, & Kaczala, 1982). For example, in a longitudinal study of gender role socialization during the elementary school years, we have shown that parents have gender-role biased perceptions of their children's competencies: they believe boys are better than girls in sports and math while girls are better than boys in language arts and instrumental music. The parents in this study also believe that boys are more interested than girls in sports, math, and science, while girls are more interested than boys in reading and instrumental music. These perceptions exist despite very little actual gender difference in the children's aptitudes and interests (Eccles, 1992). Proponents of a self-fulfilling prophecy view of the socialization of gender differences would argue that these differences in parents' perceptions set in motion a set of events that ultimately create the very differences that the parents originally believed to exist. But few studies have looked at the link between the experiences provided by parents and parents' beliefs. In our recent work, we have investigated how this process of differential provision of experiences is linked to general and specific beliefs, particularly with regard to gender-role socialization. The evidence suggests that parents' general gender-role beliefs influence their perceptions of individual children's competencies and interests: for example, parents who endorse the cultural stereotype that boys are naturally better at math (or sports) than girls, have lower estimates of their daughters' math

(and athletic) ability than one would predict given the girls' actual level of competence as measures by our aptitude indicators and by teacher ratings. In turn, these perceptions affect the kinds of experiences parents provide for their children: these parents provide boys with more opportunities to do math-related (and athletic) activities than they provide for girls.

This sequence is illustrated in Figure 2. This figure illustrates the theoretical model my colleagues and I have been using to study the socialization of gender differences in interests and competencies. Essentially, we are hypothesizing that parents' gender-role stereotypes, in interaction with their child's sex, affect the following mediators: (1) parents' causal attributions for the children's performance, (2) parents' emotional reaction to their children's performance in various activities, (3) the importance parents attach to their child acquiring various skills, (4) the advice parents provide their child regarding involvement in various skills, and (5) the activities and toys parents provide for their children. In turn, we predict that these subtle and explicit mediators influence the development of the following child outcomes across the various gender-steretyped activity domains: (1) children's confidence in their ability, (2) children's interest in mastering various skills, (3) children's affective reaction to participating in various activities; and, as a consequence of these self- and task-perceptions, (4) the amount of time, and type of effort, the children end up devoting to mastering, and demonstrating, various skills (see Eccles, 1992; Eccles, Jacobs, & Harold, 1991). Our initial results confirm these predictions

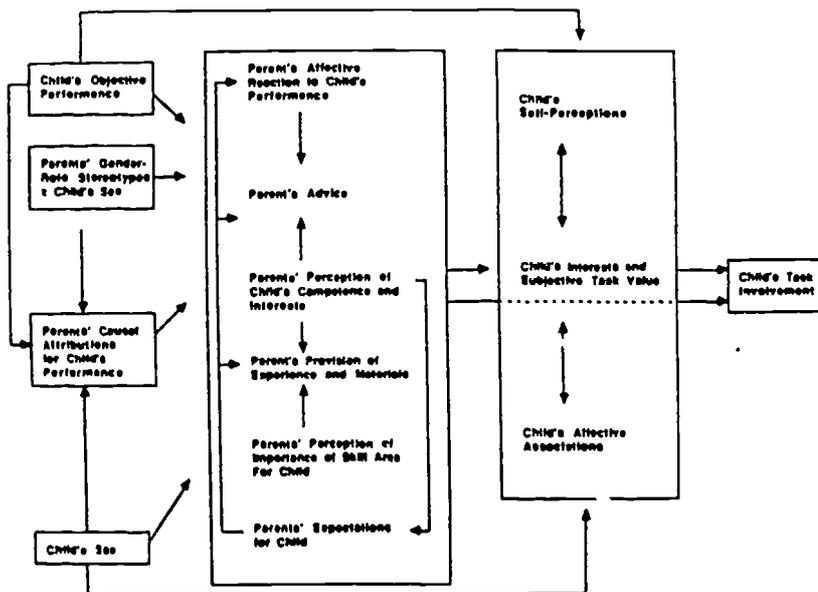


Fig. 2. Theoretical model of self-fulfilling prophecy effects in the family.

Gender-role bias in parental beliefs is evident on other measures as well. Parents in the Johns Hopkins' studies were asked their occupational aspirations for their children. These parents had rather limited occupational aspirations for their daughters; the majority of the parents of girls (between 89 and 94 percent in one study) expected their daughters to follow the traditional female-occupational pattern of working for a while and then taking time out to raise their children (Brody and Fox, 1980; Fox, 1982). The parents were also more likely to expect their sons to enter math-related or scientific fields (Brody and Fox, 1980) and to provide their sons with math-and science-related toys, kits, and books (Astin, 1974). Finally, parents of daughters reported noting giftedness in their child at a later age than parents of sons (Fox, 1982) and were often quite surprised when informed that their daughter might be gifted (Fox, personal communication). Thus, although parents have a generally positive attitude toward their daughters' intellectual talents, they do not appear to be encouraging their daughters to develop these talents in occupational pursuits to the same extent that parents of boys do. And in many cases, they appear to underestimate their daughters' talents.

Finally, there is clear evidence that mothers and fathers model different involvement in various academic subjects. Benbow and her colleagues have found that fathers are more likely to help their children in math and science than are mothers. This difference in parental behavior could influence the boys' and girls' interest in the science.

Teachers and Counselors

The data on teachers are quite mixed. On the one hand, Terman (1926, 1930) found teachers to be quite positive toward both gifted boys and girls. The teachers rated gifted girls more positively than gifted boys in terms of their performance and competence on most subjects and on deportment. In addition, boys were more often reported as being weak in at least one subject than girls. On the other hand, both Terman (1926) and Fox (1982) found that teachers were less likely to identify girls as gifted and to recommend them for accelerated educational progress. Furthermore, to the extent that teachers held negative stereotypes of gifted children, their stereotypes of gifted girls were more negative than their stereotypes of gifted boys (Solano, 1977). Finally to the extent that teachers treat boys and girls differently in the classroom, these differences are most marked among the brightest students in the class (Brophy and Good, 1974; Parsons, Kaczala, and Meece, 1982).

Both Fox (1976) and Luchins and Luchins (1980) present an even more negative picture of teachers. Fox (1976) found evidence of active resistance on the part of some teachers to continued accelerated math training for the girls who had participated in the Johns Hopkins Summer Accelerated Math Program. Furthermore, the presence or absence of teacher and counselor support for continued participation in accelerated math training was the major factor distinguishing between

the girls who continued and the girls who chose to drop back into a more traditional math program. Similarly, in their study of female mathematicians, Luchins and Luchins (1980) found that 80 percent of the females, as compared to only 9 percent of the males, had encountered active discouragement from continuing their math training; this discrepancy was especially pronounced during the college years. Similar results characterize studies of more typical populations. When bias exists math and physical science teachers provide boys with a more positive learning experience than girls (see Eccles, 1989).

Evidence regarding the role of counselors is sparser but equally troublesome. In general, counselors have not been found to be especially encouraging of non-traditional educational and occupational choices for either boys or girls (see Eccles and Hoffman, 1984). A similar pattern characterizes the few available studies on the role of the counselor for gifted students. For example, counselors have been found to actively discourage gifted girls from continuing their accelerated math training program (Fox, 1976). Likewise, more than a quarter of the gifted adults interviewed by Post-Kammer and Perrone (1983) reported that their high school counseling had been poor or inadequate. Similarly, Benbow and Stanley (1982) found that less than 12% of gifted students they identified in their talent search were participating in any special programs; thus, the majority of gifted children are not receiving any special opportunities designed to facilitate the development of their extraordinary intellectual talent. And girls are less likely than boys to be among the few who do receive these special opportunities: For example, only 6% of the girls compared to 11% of the boys in the Benbow and Stanley (1982) sample were in special programs.

These results are especially disturbing given the growing body of evidence that teachers and counselors can be an important source of encouragement for gifted girls. Several studies have demonstrated the positive effect of supportive teachers and well-designed classroom intervention programs on gifted and talented girls educational and vocational plans (e.g. Erdy and Fox, 1980; Callahan, 1979; Casserly, 1980, Fox, 1976; Fox, Benbow, and Perkins, 1983; Gordon and Addison, 1985; Tomlinson-Keasey and Smith-Winberry, 1982, 1983; Tobin and Fox, 1980). For example, Tomlinson-Keasey and Smith-Winberry (1983) found that a strong positive association between gifted girls' interest in high level careers and their involvement in high intensity special programs for the gifted.

Pat Casserly (1980)'s work provides another clear example of this. She identified the 20 school districts in the United States that had the best record of enrollment by talented females in their advanced placement courses (AP courses) in math and science; she interviewed students, teachers, and counselors at these schools regarding the factors that they believed accounted for the high participation rates of the female students in these courses. Several themes emerged rather consistently across the districts: early placement in a curricular track that leads automatically to the AP (advanced placement) courses; high proportions of females in the classes from the beginning of

the tracking sequence; active efforts to allow female friends to stay together in these courses; active support by the teachers of the females' interests, confidence, and, perhaps most importantly, participation in class activities; active recruitment of younger females into the courses by the AP teachers and by female students already enrolled in the AP courses; active career counseling by AP teachers within their classes; and creative, non-competitive instruction in the AP classes.

Casserly's study clearly suggests that supportive teachers can play an important role in encouraging gifted and talented females to develop their math and science skills and to consider seriously careers in math and science. Casserly's study also indicates that early acceleration may be important. Several studies suggest that adolescent gifted girls are less attracted to special programs, particularly in math and science, than adolescent gifted boys (Fox, 1976; Fox, Benbow, and Perkins, 1983; Tobin and Fox, 1980). In contrast, accelerated programs begun in elementary school have as many, if not more, female participants as male participants. Furthermore, both girls and boys enrolled in such programs retain their accelerated status throughout high school and graduate at an earlier age than their non-accelerated peers without any apparent deleterious effects on their intellectual and social development (c.f. Callahan, 1979).

Finally, Casserly's study points to the importance of instructional strategies themselves. The AP teachers in her study were especially likely to include career counseling in their courses, to use non-competitive teaching strategies, to include applied concerns drawn from fields such as engineering, design, medicine, and architecture, to stress the creative components of math and science rather than facts and endless word problem sets, and to be actively committed to nonsexist education. Observational studies of science teachers suggest that a similar set of characteristics differentiates teachers who produce high levels of interest in science among their female students from teachers who do not (Kahle, 1983).

Further support of the importance of these characteristics is provided by Fox (1976). Concerned with the low participation rates of gifted girls in the special program being offered at the Johns Hopkins University for gifted children, these researchers designed a special math class to attract females. This class incorporated many of the "girl friendly" principles uncovered by Casserly and Kahle: It was taught using cooperative learning strategies and included career guidance. In addition, it was taught by females and all the students were females. The class was successful in increasing the participation rates of those gifted female students who successfully completed the program. Unfortunately, longitudinal follow-ups of these students indicate that the long range impact of this experience was minimal, suggesting that one shot interventions are not very effective in producing lasting change and that "girl friendly" practices need to be a continuing part of gifted girls educational experiences (Brody and Fox, 1980).

In summary, these studies suggest that certain instructional styles may be turning girls off to math and physical science - strategies such as competitive learning strategies, heavy focus on the

mechanical applications of math and physical science rather than more people-oriented applications (such as designing more liveable communities or preventing pollution). To the extent that girls and boys come to school with different value systems (see earlier discussion), courses should have different appeal to girls and boys if the courses incorporate particular value systems into the material used for instruction (e.g., if the teachers use competitive rather cooperative learning strategies or if the teacher relies heavily on thing-oriented examples rather than people-oriented examples, or if the teacher does not make sure that the students are exposed to female as well as male role models and that female students get to participate just as fully as male students in class discussions and class activities). Furthermore, these studies indicate that math and physical science do not have to be taught in these ways; more girl friendly instructional approaches can be used. And when they are, girls are more likely to continue taking courses in these fields and to consider working in these fields when they become adults.

Conclusions

As is true in the population-at-large, gifted males and females differ in their educational and occupational patterns in a rather gender stereotyped fashion. This article explores the reasons why this might be true and outlines a research agenda to study these hypotheses. Gender-role beliefs and schema seem especially important influences in that these schema can affect both expectations for success in a wide range of activities and the subjective value individuals attach to participation in various educational, occupational, and family-related pursuits. The beliefs and behaviors of parents, teachers, counselors, and peers are also critical. These socializers appear to lack confidence in girls' ability or motivation to succeed at math, engineering and physical science and they do little to foster girls' interest in these fields. Given the omnipresence of gender-role prescriptions regarding appropriate occupational choices for women, there is little basis for girls to develop non-traditional goals if their parents, teachers, and counselors do not encourage them to consider these options. And there is even less basis if these socializers actively discourage such consideration.

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TURNING THE TABLES

*Counteracting the academic effects of male anxieties
through information about sexual origins of early human logic**

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1. Existential anxieties ¹

At conferences on women's education girls and women are usually taken to be the natural source of all the main conference topics. In connection with women's education one assumes that about boys and men and their motives and career choices there is nothing of much relevance to be said. To talk about men would then seem a waste of time. Women and girls are taken to constitute the whole problem field, and so one treats them (us) as the main objects of research. *Women* are seen to have frustrations, anxieties, and surroundings that stimulate or stifle their cognitive development. In our time, one proudly says, we have finally become alive to the inner emotional world of girls and women, to their expectations, aspirations and anxieties, as factors in women's choice and decision processes.

These new academic pursuits are not wrong, but are so far only half measures. But halfway measures can be improved upon, they can, and should, be supplemented - provided we still want to change the world.

In this talk I shall mostly talk about men.

2. Men's anxieties, and Lushin's Defense

The existential anxieties of some men have clearly affected their own intellectual work in fundamental manners. In fact, this holds of very many philosophers, mathematicians and scientists of the male sex. This I believe quite a few people would be ready to admit. However, the precise manners in which their anxieties have contributed to their theory construction cannot be analysed in a wholesale manner, as some people seem to hope. The complexity of science, of its surface history and of its mental history demand that cognitive problems relating to men's existential anxieties are studied one by one. In a few minutes I shall offer some examples.

The main point here today is that the intellectual effects of the existential anxieties of many males have been damaging to many, and still are. They have particularly, though not exclusively, been damaging to females. Their intellectually damaging effects on women can be studied as resulting from women's **induced intellectual anxieties**. And these induced intellectual anxieties should certainly not be registered as "(natural) female character traits".

But if one wants to get women's induced intellectual anxieties into focus, then it seems reasonable first to take up the original male anxieties as - relatively new - objects of research.

I should like to offer two components, A and B, of an explanation for the existence of such induced anxieties.

Component A has two sub-components, and so has B. The four, A1, A2, B1 and B2, are often mixed up. Components A1 and A2 concern decision making, especially men's decision making. Components B1 and B2 are primarily related to the *situation* with which women are confronted.

Both A and B concern the need for self respect. I take for granted here that a clear image of own "gender identity" has always been an indispensable requirement for easy self respect, possibly a necessary condition, for most people. Now how can boys and young men attain their feeling of human value and their social and cultural "identity"?²

Component A1 is the following hypothesis concerning this existential problem:³

Boys very often solve it by distancing themselves from their immediate surroundings, sometimes - as do many mathematicians, theologians, chess players and clerics - from all of the practical world, from a rather early age onwards, because for them the possibility of acquiring a (safe, positive) identity experience through inspection of their own physical nature is perceived as being blocked. Boys are not given the anatomical possibility of identification with the person who usually takes care of them and loves them and whom they themselves first love and trust. If you are a boy, then you will soon perceive that you are not like your mother, who is a woman, nor will not ever be. You will therefore have to become a different type of person than she and the likes of her. In order to become different, and in order to show yourself and other people that you are different, you will *have to take distance*, at least in some respect, and you will *have* to get your act together and get yourself organized **at a distance**. Let us call this:

A1. Self respect through Identity acquisition at a distance

It is nice to play with an expression taken from classical physics, and to speak of:

A1*. Self respect through (intended) action-at-a-distance.

No field theory here!⁴

This existential need for preoccupation at a distance often leads men to complete obsession with things that can satisfy this condition - all kinds of more or less crazy things, from chess to "pure" mathematics or to the construction of machinery that **cannot be used around the house**.⁵

It is not really necessary to assume a genetic basis here. Logically it suffices to understand to the full that very many men have such existential anxieties, and to understand the needs that issue from those anxieties; and the manoeuvres, often of a cognitive nature, chosen to solve the problems issuing from those needs.

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The said solution to this existential men's problem can be associated with an assumption of higher cosmic or social status, but it need not be associated with this assumption. For this reason it seems to me wrong to identify this existential technique of identity acquisition, A1, with the technique of identity acquisition by **elevation of self** "above" other people, which I shall call:

A2. Self respect through self elevation.

I believe that A1 and A2 are often confounded. It is with the first existential technique we should be concerned here, that of **gendered identity acquisition at a distance**, the acquisition of a positive image of self through detaching oneself and one's activities from the concrete and familiar world. This existential technique serves a need that may occasionally arise in a young woman but which understandably arises more easily and strongly in boys and which in boys seems to be rather common.⁶

The presence of this subjective need in, as it seems, very many boys and men, leads many of them to develop various strategies in the struggle for life that women do not, or less often, employ, and which many women do not know about.

Thus our hypothesis can explain, among other things, the academic successes of the ideals of *anonymity* and *neutrality* in scientific reportage, an ideal "objective" style of writing that is still well known in our time. This style demands, among other things, that no reference be made to individual persons and no mention be made of named persons' feelings and likings and so on in academic reportage and debate - which I personally think is a very good norm indeed.

However, this style also demands that no reference be made to the various **roles and functions of the participants in the laboratory** (in the experimental setting leading to later theory formation), nor to the **communicative roles and functions of theory consumers** (e.g., as participants in scientific debate⁷). Worse even, this ideal demands that also the **cultural roles of the theoretician** - scientific, political, social, educational - be left unmentioned.

I should like to give this masculine strategy, our theory component A1, a certain literary name: **Lushin's Defense**. In memory of the tragical hero in Nabokov's in the novel with this title, his touching and rather lovable professional eternal chess player. Women may adopt this strategy but it seems to be far more common among males, which is what I mean by calling it "masculine".⁸

This strategy alone already is enough to deflect and discourage women's educational and professional aspirations, an observation which I shall not further discuss here.

Now I come to a factor or explanation component B, that concerns the resulting *cultural* situation for women, but that is less well documented and recognized than component A. There seems to me to be a field-related nearsightedness in the methodology of the social sciences, leading to deplorable blanks in the arsenal of explanatory patterns. Questions are formulated concerning the influence from teachers, parents, friends, and other social factors. There are also some attempts, I believe, to assess women's fear of social isolation by certain career choices. So the immediate or future social surroundings tend to get some scientific attention.

But can we expect ever to get where we want in this manner? When contemplating career possibilities there is also, although no one talks about it, a girl's anxiety and **estimate** - wholly conscious, half-conscious or totally unconscious - **of future exclusion from our culture as a whole**. Is not this anxiety, and her estimate of the degree of cultural exclusion she will have to face, just as important factors in a girl's or young woman's decision making as her anxieties concerning a certain measure of *social* isolation?

How to measure this female fear of cultural exclusion? I would not know, but it does seem to be a factor of importance. Taken as a whole, our culture is (and other contemporary cultures are no better) completely discouraging for girls who get it into their heads to contemplate a career in, say, the technical sciences. If they choose such a career, they choose for a life in which they are constantly reminded of not belonging, or of belonging only in a non-normal sense. They are reminded by their social surroundings - by family, friends or teachers, certainly, but also by their

cultural inheritance: by literature, by show business, and the arts, and by behavioral etiquette, religion, fashion, and philosophy. These continual reminders are registered, though not always consciously, and in any case their total impact is almost never articulated. But a girl almost always somehow knows, from her early childhood, that an unusual education will make of her a person without a culture - i.e., **without a supporting culture**, or, a person "without cultural identity". The culture she was born into is then **no longer hers**.

An old American Indian said to Ruth Benedict, the cultural anthropologist: "Every man must drink his life out of a cup; and mine is broken." Read "every girl", "every woman", and you may get what I am trying to say.

This means that we are concerned with the fear that, in the role in which the science or career choice in question puts you, you will never (again) feel a natural part of, and at home in, our culture as a whole.

To a culture we shall then have to count all non-natural sources of future impressions, from Goethe, with his "eternal Feminine", to contemporary fashion and hard porn. Let us call this:

B1. Fear of cultural exclusion.

Obviously, this is *not* the same as:

B2. Fear of social isolation.

Let me sum up. What I call A1 and B1, that is to say contemporary boys' and men's need for identity acquisition at a distance - from home, but **inside our culture** - together with the anxieties their strategies induce in women, as well as women's induced **fear of cultural isolation and exclusion** due to our male-based historical culture as a whole, these are two immensely powerful factors in bringing about contemporary men's and women's actual choices, and in determining their successes and failures.

Clearly, counter-strategies are mandatory.

3. Countcracting cultural exclusion

In the following the word "tuition" is to stand for tuition in the exact, natural and technical sciences. The strategies I shall discuss here concern tuition - class-room tuition as well as textbooks - in these sciences, in particular, but not exclusively, in relation to female students. What I recommend is:

that certain aspects of the early human choice of categories for scientific description and problem solving be integrated into the tuition in the exact and the natural sciences, together with the subsequent debates and theoretical developments.⁹

I am referring to those chapters of the history of scientific evolution that demonstrate an entanglement of early theoretical categories with human biological experience - and male existential anxieties. And I very seriously recommend that students be familiarized with the hidden roots of many cognitive forms, that they be shown how cognitive forms are often rooted in aspects of the biosphere connected with human sexuality and procreation - and thereby with problems and fears about that part of reality. I am talking about categories of thought that are the scientific predecessors and sometime competitors of present mathematical and scientific categories.

One is not supposed to talk about it, but in every single historical period many males have been extremely afraid of the power women can hold over them, and this is particularly conspicuous in connection with human procreation and human love. The history of the development of the sciences carries imprints of these fears, in all probability in more respects than I can show here.

Today women are less tortured by those older categories of thought (below) than they were in the nineteenth century.¹⁰ Science now usually has better stuff to offer than the idea that all is Sex. The development in mathematics and the sciences has not been all to the worse for women in philosophical respect.

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The gist of my argument is this: girls and women are, we said, suffering from the male strategy which I called Lushin's Defense - a total withdrawal into the non-familiar, impractical, non-natural, "pure". Even a life devoted to the technical sciences can be arranged so as to suit this general purpose - to say nothing of a life in mathematics. A girl would presumably fare mentally better if she were taught to see that what I have called Lushin's Defense (or, better, Lushin's No. 1 Defense) is essentially a defense against very real and *understandable* male anxieties. And similarly, if she would be taught what other existential anxieties and defensive strategies poor Lushin has been preoccupied with throughout the ages, then his stratagems for coping with them would be considerably less discouraging and depressing.

Some of these stratagems involve concept formation. In fact, surprisingly many of the early central categories in mathematics and in the sciences, too - and not only in politics - turn out to be rooted directly in the experience of biological phenomena, particularly in the experience of procreation and heredity, and in a male-favouring (sexist) anthropology. Whereas more modern categories and theories may well be studied as a *disentanglement* from such biological and sexist roots.

For example, the Greek belief in a geometry based exclusively on symmetrical relations - similarity, congruence, identity - suggests a firm belief in the all-embracing importance of categories that are brought to our attention in the phenomena of heredity (as they looked to Europeans before Darwin).

The initial entanglements have to some degree been investigated, but the later disentanglement from biological roots has largely remained unanalysed as such. There is a job to be done here, a new type of textbook to be written that includes this material; for both the early roots in, and the later disentanglement from biological (sexual) categories are, in my estimation, ideal topics for young women's education in exact and natural science. Why? Because such information will presumably take away much of the mystery of scientific category and theory construction. It makes the persons throughout the ages who have constructed scientific categories and theories

more human, sometimes perhaps more ridiculous - and so less to be afraid of, but sometimes more attractive as "heroes" - also for women.

Ghetto constructions of the organisation of university life, such as setting apart special courses and subsuming them under Women's Studies, are not required for this educational purpose. In my opinion it is not even desirable. Very many male students turn out to be as interested as their female colleagues in such analyses, and it would be unjust to these men to keep them out.

Nor would it be right to retort that the topics in question are not really crucial to the cognitive evaluation of newer and better theories. Male students, too, ought to be shown how, since Galileo, a growing number of men have tried, not without success, to disentangle human thought from these biology-centered forms of thought and the anxiety-based rationalism that surrounded it. A partial success is undeniable.

That is to say, is it not reasonable to expect that by familiarizing students with this material one can expect to enhance women's confidence in the intelligibility of the cultural world; and so to enhance their inner intellectual freedom and constructive courage? And so to open up for *their* daring theory and machine constructions? (The question whether women's theories and inventions are ultimately likely to resemble men's is not at stake here, nor is the question whether they ought to.)

Is it not reasonable to assume that academic openness about the influence of masculine existential anxieties on scientific category construction can reduce the induced intellectual anxieties in women, at least in sufficient measure to make these anxieties quite controllable? And that such openness in science tuition can bring women's fear of cultural exclusion to dwindle?

And is it not reasonable to assume that such academic openness will contribute to men's awareness of their own existential anxieties, and of how common these anxieties always have been - whereby they become controllable and recourse to extreme strategies superfluous?

These expectations call for a considerable amount of rewriting of courses and textbooks, to start with in logic and mathematics, two fields upon which most technical sciences in *some way* depend.

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I shall give a few examples that I personally find fascinating and to the point. They concern the following (historical) categories of scientific thought:

Direction; Contrariety and "Or"; "Infinitesimal"; Debate; Relations between "logical individuals" (things, persons, ...) as against "Character traits" (of each individual separately).

Obviously I cannot here deal with them in any detail and I cannot here prove the correctness of what I say, for lack of time, but I can give you exact references to published material, should you so wish.

4. First example: A language for a logic of Direction

4.1. Anthropology and the logic of Direction. In classical times one assumed all *relations* of philosophical or scientific importance - mathematical relations, for instance - to be symmetrical. Geometry was set up by the old Greeks in terms of "similarity", "congruence" and so on. And academic logic did not consider relations involving asymmetry and direction until the end of the nineteenth century; with one exception.

The exception was a postulated meta-physical relation of "degrees of perfection", a relation of value based on the doctrine that it was possible for things to "be" of higher and lower metaphysical value, and for man, to *progress to higher and higher value*. Up to about 1900 that metaphysical ladder of progression, that hierarchy of "value", or "real Being", was seen as the only asymmetrical relation that had anything to do with basic categories at all. Other directions and comparatives were totally disregarded, they were held to be of no relevance for the situation at the "higher" levels. The *vector concept*, the notion of a directed magnitude (or potency, or strength, e.g., a force), with components in many different dimensions, was unthinkable throughout the greater parts of the European cultural history - it dates only from about 1800. The concepts *enantiomorphy* and *tensor* are younger still.

Inside the old logical framework of Being and Property - or Substance and Accident - one had no way of dealing with a relation like *A ranks*

higher than B, or A is more valuable than B. For already such simple and familiar vehicles of thought as comparatives - all of them! - fall outside that logical framework. And one had no means of *measuring* this comparative, not even in the weakest sense. Hence there seemed to be no way in which a thinker could communicate his own outlook about metaphysical ranks clearly to other minds - that is to say, not without transcending the logical confinement, known from Aristotle, to objects (beings) with properties.

I shall briefly sketch an early attempt to represent rank, order and direction, as this problem presents itself within a metaphysical theory of values, and to do so without going beyond the layout of beings-with-properties.¹¹

One finds this attempt in the works of Philo of Alexandria, a Hellenistic Jewish thinker who lived, wrote and published around the year zero.

In 1970 an American classical scholar and theologian, Richard A. Baer, published a very original book about a certain feature of the general arrangement of Philo's thought. It concerns his remarkably wide use of the categories Male and Female.

"I saw that the categories male and female occupied more than an incidental place in Philo's thinking", Baer writes (p. ii). Philo turns out to use these categories not only for discussing matters of sex, gender or procreation, but often also for other topics.

We can learn from Baer something of interest for our present purpose; for what Baer shows us becomes particularly interesting when studied from a logical point of view.¹² In fact Baer himself does that, in as much as he repeatedly uses expressions pertaining to logic, as "logical order of creation" and "functional-analogical use" (pp. 28, 34, note 4). Philo works within "the philosophical framework of genus and species, potentiality (*dynamis*) and actuality (*energeia*)" (l.c.), and "states that the man corresponds to *nous* and the woman to *aisthesis*."

Aisthesis is the world of the senses, *nous* is reason, "created to rule over *aisthesis* and thus in order of importance logically precedes *aisthesis*" (p. 39).

We are concerned - also in Baer's opinion - with *the logical problem*

of representing order, non-symmetrical orderings. To develop cognitive representations of order is a logical task, pertaining to each and every field of interest. Things with properties is not all: structure and order occur in all domains of experience and must be represented in the mind and in language, are we to reason about them in a systematical manner. The basic problem of representing asymmetry is the same in the case of spatial relations as in the case of temporal relations and relations of intensity (temperature, strength of material, fields of force).

What Baer has discovered in Philo's texts is his crude, sexist solution to that general problem as restricted to value judgments.

It would not be surprising if you were still nonplussed. "This may be of importance for some," you may now say, "but how can the point that Baer makes about Philo of Alexandria be described as a *logical* point, pertaining to man's earliest attempts to reason and argue logically?"

Argument presupposes mental layout and communication! Philo makes, Baer says, a "functional-analogical" use of the categories Male and Female.¹³ A functional use - but of a certain kind: *he uses these words in order to express the relative ranks of two items standing in a certain non-symmetrical relation, even when the items are not a woman and a man.* And this is done in analogy with the assumption that the essential Male (whatever that may mean) ranks metaphysically higher than the essential Female. Philo's negative comments about actual women serve, in his written work, mainly as a preface to his subsequent remarks about the perceptible world as a whole: "It is clear, then, that Philo extensively exploits female terminology as a vehicle for expressing his wide-spread depreciation of the created world" (p. 41f, 45.)

The point may be put like this: Baer has seen that Philo employs an *ordered pair* of "essences" presumably known to all, <the Male, the Female>, for referential use in a much wider type of discourse than biology and anthropology, namely, for use in connection with *value judgments about the created world generally*, of whichever sort, and whatever the items of the comparison are. Although he does not use a logician's vernacular of "ordered pair", or "couple", the classical scholar and theologian Baer has

seen what is at stake and has made this historical insight accessible to us all, an achievement for which he definitely deserves our gratitude.

Philo knew that he could employ this usage of "the Male" and "the Female" towards his readers and expect to be understood the way he meant it. The ordering of the items that he had in mind would be understood in the right direction. For Philo could depend on a certain anthropology, familiar to all, that immediately would make all his readers interpret any item called "the Male" as ranking higher in perfection than any item he called "the Female".

But then (we may add) Philo and thinkers like him might as well say *y is the male, and x is the female* in connection with the relation *y is longer than x*, since they can also to a reasonable degree depend on their listeners' knowledge of men's and women's average lengths in order to trust that the relation is understood in the direction he intends to communicate.

Today logic is no longer monadic. The theory of inference we now have works as well for relational predicates like *y is more valuable than x* as for property predicates (like *y is valuable*). Hence there is no need for a reduction of relations between *x* and *y* to properties of the one and properties of the other. Hence Philo's technical use of "Male" and "Female" in the theory of values is quite superfluous.

Philo's anthropological conceptualization of the very category that we call Order is in all likelihood the very first published general explanation of the notion of Order in human history. It precedes the first publication on Direction in geometry by eighteen hundred years. And it precedes the set-theoretical definitions of the notion of "an ordered couple" by nineteen hundred and fifty years.

4.2. Vector geometry and vector analysis. From Philo to Caspar Wessel.

For we have, in fact, been speaking about the problem of representing direction. The cradle of vector geometry is the paper *Om Directionens analytiske Betegning* by the Norwegian mathematician and surveyor Caspar Wessel, presented to The Royal Danish Academy of Science in 1797 and published by that Academy in 1799. In 1831 Gauss published an influential

publication exposing similar ideas, developed independently.

Philo's thoughts on direction were concerned with metaphysical value and value directedness, that is to say, with direction in a metaphysical hierarchy, *this being the only kind of direction that the former layout of Being in genera and species was conceptually committed to*. The rest was, one hoped, a question of symmetries (similarity, or lack of same) together with non-relational ("character") traits.

The rise of vector algebra, vector analysis and a general logic that can handle asymmetrical relations without resorting to logically intractable hierarchical constructions - this whole development reflects a process of cognitive emancipation *away from sexist representational forms* reflected in the "ecstatic-cathartic"¹⁴ strand of European cognition, so eminently represented by Philo of Alexandria.

Taking this case as an example, I venture to say the following. If students could be given this background to theory constructions, new cognitive instruments would sometimes be experienced as positively welcoming women, they would have the effect of bringing them in from the cold, rather than of condemning them to the cultural exile so many women seem to expect from the sciences. A scientific development like the one we have just discussed could come to be seen as a girl's best intellectual friend, or at least as one of them. It could come to be understood as part of one line of human emancipation, one bit of the slow good-bye to sex-based reason, rather than as a masculine threat alienating women still more from the anti-feminist culture they are borne into. Here, however, scientific education has failed completely.

One final note. It is with a certain glee that I take up Philo's logic here, for when I discussed this in my inaugural lecture as professor of logic at Utrecht university twenty years ago Guess what people said to me about it afterwards.¹⁵

5. Second example: Contrariety and Either-Or

5.1. The sexual origin of Contrariety/Opposition. Already in 1912 the English historian of ideas F.M. Cornford declared the old logical category *Contrariety* to be of sexual origin.¹⁶ "Sex the prototype of Contrariety" is the title of one of the paragraphs in Cornford's book.

("Contrariety": in the history of philosophy this is an ambiguous word. In the early twentieth century, e.g. in 1912, it was usually taken in the Hegelian sense in which it is not distinguished from Contradiction: *at most and at least one of the two*, i.e., as Either-Or, rather than in the simpler Aristotelian sense: *at most one of them*, as in "Sheffer's stroke" in propositional calculus.)

The point Cornford makes - in 1912 - is of an unrivalled importance. In recent years the philosophical understanding of the connections he points to has been on the increase, possibly due to the mental impact of World War II. "Coarsely sexual ideas" - now it is 1975, and the pen is that of the German philosopher Ernst Topitsch - are at the bottom of much traditional concept formation, particularly in "the ecstatic-cathartic line in European theory of knowledge".¹⁷

In 1990 a book¹⁸ appears by an American historian of biology, Thomas Laqueur, with the misleading title **Making Sex**. It is in fact a detailed history of various concepts "Sex" in Western thought. Laqueur writes that the category Sex has been used as a cipher (a cognitive symbol) for the nature of *causality*, the central concept in epistemology. To this we can add: Sex has also been used as a cipher for the nature of a number of logical categories: for Direction, and, as Cornford pointed out, for Contrariety.

This cognitive category, which we may call Oppositional Sexuality, or Sexual Contrariety, is very old and hard to eliminate once and for all. But it was not typical of Medieval logic, which was relatively advanced, nor was it typical of Medieval biology and conception of gender. The understanding of gender was formed according to the scheme of gradual differences from "the lowest" to "the highest", women being seen as "less male" than men but with everyone given a chance to work upwards, rather than in terms of one

biological pair of fixed essences <the Male, the Female>.¹⁹

However, as Laqueur explains, the earlier bipolar thinking in biological thought returned in the course of the 18th century.

Now this crucial observation about biological categories happens to fit in extremely well with quite independent investigations about the re-introduction in European universities around 1800 of a dichotomizing logic of Contrariety. This Neoplatonic logic is known as the Fichte-Hegel logic. The person who is made especially responsible for reintroduction of this logic is none other than the ultra-sexist philosopher Johann Gottlieb Fichte:

In the nineteen-twenties the mathematician and philosopher Leonard Nelson writes about Fichte's influence on nineteenth-century German *logic* and analyses the nature of his logic. In 1968 Hans Lenk shows that according to Fichte, the concept 'concept' itself is that of *binary exclusive* disjunction. This is to say that, in Fichte's canon, the category Two has a quite unique, premier conceptual status in logic.²⁰ Not, alas, in connection with truth values - parliamentary values²¹; but at the level of general concept formation and the logical representation, in language as well as in the mind, of one's ideas. In fact there is an exceptionally strong antagonism in the history of ideas between "parliamentary values", or truth values, which pertain to statements, and binary exclusive representation of "beings", pertaining to persons or groups of persons.

In 1975 the truly extreme sexism of German "liberationist" Fichte is documented and discussed by Hannelore Schröder.²²

The combined criticisms of Fichte as offered by Nelson, Lenk and Schröder strongly suggest a connection between two seemingly unrelated phenomena (three, if we add Laqueur's observation):

1° the upsurge of *extreme sexism* in Germany at the end of the eighteenth century;

2° the come-back of the worst kind of *dichotomizing bipolar logic* in philosophy in that area, and in the same period.²³

This is more than an incidental coincidence in one man. Fichte is not alone among outspokenly misogynous philosopher "logicians" to exalt the number Two. Another example is WWII traitor Vidkun Quisling, who

dabbed in philosophy in secret. Quisling's glorification of maleness and contempt for (and fear of) the female sex can be examined in his posthumous manuscripts. In these handwritten sketches he demonstrates - from his earliest years to the end - a dichotomizing frenzy the like of which I have never seen. Still another example is the Dutch philosopher of mathematics L.E.J. Brouwer, who talks of "the intuition of two-oneness" and calls it "the primordial intuition of mathematics".²⁴ Hence for this man - not speaking with the authority of a psychologist - the number Two is more "intuitively primordial" than for instance Three. Though it has been kept hidden from the international readership, it so happens that Brouwer was every bit as fanatical a misogynist as Fichte, in this respect worse even than Quisling.

5.2. Backlash? I like to briefly mention that it is possible to see Fichte's reintroduction of this type of Neoplatonic logic at the German universities (from which it spread like a plague) as a backlash - in an attempt to exorcise "the Feminine" and thereby squelch the existential anxieties and hysterical fears of women's voices, and possible voices, raising perspectives that could make the entrails of the souls of men shiver. It is largely a matter of chronology. Fichte's two books on logic and epistemology, *Über den Begriff der Wissenschaftslehre* and *Grundlagen der gesammten Wissenschaftslehre*, were written and published in 1794. Look at this (incomplete) sequence of years of publication of works by eighteenth-century women philosophers:²⁵

- 1701, 1751 Catherine Cockburn Trotter
- 1704, 1705 Mary Astell
- 1705 Damaris Cudworth Masham
- 1720 Jeanne Dumée
- 1738 Maria Agnesi
- 1739 Sophia (pseudonym)
- 1740, 1741, 1744, 1759 Gabrielle Emilie le Tonnelier Breteuil,
Marquise du Châtelet-de Breteuil
- 1742, 1752 Dorothea Christine Leporin-Erxleben

1767 Johanna Charlotte Unzer
1767, 1787 Catherine Macauley-Graham
1787 Dorothea Schlözer
1788, 1789, 1792 Mary Wollstonecraft
1791 Olympe des Gouges (Marie Gouze)
1799 Mary Ann Radcliffe

It was unheard of. These women could write. Worse even - it was clear that they could think. They could reason. And some men got hysterical.

And changed the categories of biology and logic.

5.3. The inclusive Or is clearly not inspired by the two sexes

and the supposedly unavoidable "contrariety" between them. It is the logical category that in Aristotle is called Subcontrariety: *at least one of them*.

This inclusive Or has been discussed in the Middle Ages, in the works of William of Ockham. Then it disappears completely from European scene of published philosophy. It does not return until the nineteenth century; then another Englishman, Augustus De Morgan, reinvented or rediscovered it. De Morgan's plea for an inclusive rather than an exclusive Or was taken up by his sometime student, the economist W. Stanley Jevons.

And they won. From the representational systems offered by logic nowadays, whether in England, Holland or in Germany, the emphasis on exclusive disjunctions, on Either-Or, is gone. So in this case, at least, there has been a change for the better - away from the nineteenth century's emphasis on binary gender-based "Contrariety", "Opposition", "*Gegensatz*".

Most people in logic in the academic world do not realise (and usually do not care) what this logical shift means in human and cultural terms. But that certainly is no reason why we shouldn't, or why our students shouldn't be brought to understand the kind of cognitive turnabout this has meant.

After World War Two a new upsurge of old anxieties could be seen in many countries. Such existential anxieties as the war brought with it - in Germany, deeply wounded male pride, combined with wounded national pride, after the loss of yet another war - explain why in the 1950's and 60's there was a plea, strongly polemical, precisely in Germany for the reintroduction of the exclusive "Or". *Either Male or Female, either Friend or Foe*. This was claimed to be the "most important", the "philosophical", understanding of "Or", pertaining to *any* concept or domain of application whatever.²⁶

Whereas, in the meantime, logic had discarded this dichotomizing and polarizing particle as, mostly, grossly misleading for the representation of the outer world. In scientific and philosophical description other representational forms had taken over.

6. Third example: Mathematical Analysis

6.1. *Infinitesimal calculus and General Value theory*. At the beginning of this talk I mentioned some existential strategies, and among them a desire many men have to establish themselves as belonging to a world that is situated at great distance from the familiar world.

"Infinitely" far away, if that is possible! "Actual infinity" has been a great favourite among thinkers with a mathematical bend. What I should like to discuss next concerns a cognitive category related to this need: that of "the extremely small", the Infinitesimal - another favourite of many men. In the old metaphysics, weight, spatial extension, and quantity generally were associated with Matter and the Female. Power, therefore, resided in "the extremely small", that which had no weight, extension or quantity.

My third case story concerns the origins of the Differential and Integral Calculus, or "the Calculus", for short. This cognitive apparatus was developed independently by Leibniz and by Isaac Newton, from different basic categories. In its German inception that smart conceptual apparatus was concerned with *extremely small entities*, or "*Infinitely small magnitudes*",

and so it was called the "Infinitesimal calculus".

This cognitive category, the Infinitely small, was not originally invented for the benefit of mathematical physics. Far from it; for on the European continent it had for a very long time been part and parcel of the categorial apparatus of human cognition. You find it in old theories in many other scientific, pseudo-scientific or cultural fields than mathematics and physics.

In fact, the cognitive category Infinitesimal started out, just like Direction, as a category *within the traditional metaphysical theory of value*.

(1) You find this old cognitive category of "infinitesimal things" in the pictorial arts, in the strange reverence people in certain centuries had for miniature paintings. The point is that such paintings were assumed to have an especially high value due to their very smallness.²⁷

(2) You find it in homeopathy, in the homeopathic doctrine of how to produce valuable, potent medicine. Homeopaths insist, without offering any explanation, that in order to attain its power the medically active ingredient must, if it is a solid, be ground into a very fine powder; if it is a fluid it must be diluted, until the chance that you find as much as 1 molecule in a spoonful of the dilution is lower than Avogadro's number, 10^{24} .

(3) I claim that you also find it in Anorexia nervosa. The afflicted persons are mostly young women who try to lose as much weight as possible; some are prepared to die from loss of weight, rather than have anything like a normal human mass of flesh and bones. Why?

These persons seem to me to act on a certain assumption that is stored somewhere deep inside their brains, the assumption that the smaller and closer to absolute weightlessness, the better. Why again?

Therapists today seem to agree that anorexics are trying to achieve some kind of power, that Anorexia is - in feminist terms - geared towards self empowerment. That is to say: *Small* is, for them, *Powerful*.

Anorexics do not themselves express this. But neither did Samuel Hahnemann, who founded the homeopathic school in medicine, nor do his followers. *Why* does neither group attempt any kind of explanation for their

fascination with weightlessness? Why didn't Hahnemann formulate this earlier principle of European thought? And why don't anorexics formulate it?

Because it concerns a certain strand in European cognition, a certain mode of thought, a cognitive principle that is taken for absolutely granted, like elementary arithmetic.

It is possible to give an explanation to all of these three mysterious subconscious cognitive attitudes or beliefs. My thesis is this. Perhaps in all of mankind, but at least in Europe, human cognition has developed on a basis of a deep respect for *seed*, of any kind. Vegetable seed, grain in particular, and still tinier plant seeds, all clearly possess power. From an early moment in the history of mankind it must of course have been clear to anyone that human life depends in large measure on the incredible powers of tiny little plant seeds. That seed is powerful is undeniable: whole plants, enormous trees sometimes, with eatable leaves and fruits on them, develop from one little, almost invisible thing!

Richard Baer (above) has done women a great service in pointing out the sexual origins of certain types of human logical vernacular. But don't forget that an older Von Baer, the German medical man from Estonia, was the first to discover and publish (in 1827) that humans and dogs and lions also produce *eggs*. One need not be a bird to produce an ovum! And so von Baer had proved, by means of keen observation, that *not only the males* in the human species were active participants in the process of conception.

Whereas until then, no knowledge of mammalian eggs being available, "everything was born from seed", and from seed alone. Seed - *terribly small things* - held all the power.

Deep in your brain, Power may then easily come to seem inseparable from smallness, to require, even to *mean* smallness, thinness, weightlessness. And if that is so, self-empowerment *requires* loss of weight. There is no way around this (automatic, unconscious) "conclusion".

6.2. *Weierstrass*. Now what about the Calculus, on the European continent for a long time called "the Infinitesimal Calculus"?

As many of you will remember, in school or university courses the word "infinitesimal" was hardly ever spoken, the old name of this branch of mathematics notwithstanding.²⁸ Instead one learns about *limits* of series of fractions $\text{delta } y : \text{delta } x$, for decreasing choices of $\text{delta } x$. Here, not only are x and y themselves ordinary real numbers, obeying the same arithmetical laws as all other reals, but $\text{delta } x$ and $\text{delta } y$ are plain real numbers as well. They are not something special, called "infinitesimals". And you may remember that this came about because around 1900 a certain mathematician, Weierstrass, had managed to reconstruct the said Calculus from concepts that had no connection with that old category: the (potent) Infinitesimal. Instead he appealed to Cauchy's notion of the *limit* of some decreasing series.

What does this mean?

That the Differential and Integral Calculus can be studied, taught, and used with no reference what so ever, direct or indirect, to seed.²⁹

"A pity," you may now say. "I quite like the idea of seed, and the cognitive category of Seed, at least I like it *much* more than that chilly and difficult mathematical notion of Limit. Seed *is* important, and it may be male, but *at least it is human!* That forbidding category called "Limit", on the other hand, seems to be a part of exactly that closed abstract world to which, as you said, nervous males take refuge in order to forget the realities of life. So what's the big deal?"

6.3. *Weierstrass in dialogical terms* Is Weierstrass' theory "chilly", you said? And did I hear someone say the other day that, *being formulas*, these formulas *ipso facto* are "masculinistic"?

Let me tell you what happened next in academic logic. The scene is still Europe. Based on work done by the Dutch logician Evert Willem Beth in the nineteen-fifties, a German logician, Paul Lorenzen, in 1960 was able to show that (in my terms) *modern logic need not be seen the way the boys with the strongest existential anxieties prefer to look at it*: as a refuge from the

daily world, with its physical and political terrors and the risks posed by the existence of women - a domain of pure mathematical abstraction. Thanks to these two logicians it is now clear that modern logic is not that old theory of Being, so dear to dogmatists of all hues. On the contrary! It can now be seen to consist of collections of rules precisely for dealing with certain types of disagreement about the physico-political world in an undogmatic and *non-violent manner*, through unprejudiced dialogue and critical discussion.³⁰

And this does not mean the kind of "discussions" we women are so often treated to by haughty anxiety-ridden men, inside and outside the universities. We are talking instead of person-to-person discussions between equals, where the topic is announced in advance and where no one can rightfully hold you back or even force you to participate.

Serious, but orderly and polite discussions with other humans, including women: is this not precisely what so many men have always been so terrible afraid of?

Yes, it is one of the things that many men have always feared more than of anything else. Excellent examples are Carl Schmitt and Vidkun Quisling, Nazi's of world renown. Or take the "intuitionist" mathematician L.E.J. Brouwer. One did not discuss; as Male, one *acts* and *creates*. To say nothing of discussing with women - the very idea made them sick.³¹

So what again? Were we not talking about Cauchy and Weierstrass and their darned mathematical doggedness, their constant circling around the Differential and Integral Calculus?

You see, I now combine the two: the Cauchy-Weierstrass rendering of the Calculus, without "infinitesimals" with their historical roots in Seed - and the (Beth)-Lorenzen rendering of Logic itself as the theory of critical discussion. And what do you get?

You get a dialogical interpretation of Weierstrass' set-up of the differential and integral calculus. When reformulated in critical-dialogical terms, Weierstrass' famous formula:

"For each ordinary ("real") number, call it ϵ (epsilon), *there is* an ordinary number, call it δ (delta), such that ..."

(and so on), penned down in the *is*-based terminology characteristic of the nineteenth century, now attains the following profile:

"You seem to doubt what I say about how to calculate the derivative $f'(x)$ of the function $f(x)$, and its value at x .

However, **you** may set a tolerance for the error I may make concerning the value of $f'(x)$ at x in practice (that concerns, say, the dimensions required for the safe construction of a certain aeroplane or bridge)!

For I hold that, for **any** tolerance of an error (ϵ , or epsilon) of mine that **you** may set, as long as it is a measurable size, I can pick a rational number (δ , or delta) such that - and I can show it to you if you so wish - provided the free variable's deviation from x is smaller than δ , my estimate for the value of the derivative will always be within the error ϵ that you will tolerate. And so there is no danger as long as we remain well within this distance δ from x ."

6.4. Debate-inter-pares or monological Reason-at-a-distance? We have studied a slow cognitive change from a theory in terms of potent male seed, highly discouraging for women, to a theory in terms of the debatability of claims (pronouncements), in a debate among absolute equals. There is no threat. There are no popes. Exclusive disjunction is gone, social contrarities immobilized. In the theory of the exact sciences there is no division of the sexes. Logical opposition is not social opposition, the opponent is not attacked, only his or her statements.

In *logical* theory, and in *logical* practice, you are now *inter pares* - among equals. And as for mathematical theory, even Weierstrass' definition of limit can now be reformulated in terms of **You** and **Me**, your tolerance as to my possible error and my way of tackling that tolerance. Gone is the category of Absolute Seed, with its infinitely small size, or sizelessness, as one should really say, and its power.

Gone, too, is the implicit reference to the assumption of only one human procreative component, or *sex*. The philosophical category of Reason was, in fact, the category of men's Reason-at-a-distance-from-women; this

category is now replaced by - no, it has *developed into* - the category of Reason as Debate *inter pares*.

In the mental programme determined by the category Infinitesimal, the fundamental mental category *Power* logically implies, we said, lack of quantity, including weightlessness. Self-empowerment therefore logically implies, and so in practice would seem to require, loss of size and weight. The English philosopher Berkeley hit the nail exactly on its head when he criticized the mathematician's "infinitesimals" as the "ghosts of departed quantities". *Anorexics are persons who try to become mere ghosts, of departed bodily quantities.*³²

Now suppose our culture would understand what is cognitively at stake here, and suppose it would care about it. Then the terrible affliction of Anorexia would be quite pointless. It would not be needed from *anyone's* point of view. Nor could it be communicated to others - as it still is, in strange and secret and subconscious manners of which we today have no survey.

What would have come into our culture instead?

A penetrating emphasis on dialogue, sometimes on debate - always ridiculed by Reasoners-at-a-distance - maybe highly critical, but among equals. I believe that feminism as well as parliamentarism would be pleased with such a replacement.

The analysis of mathematical functions from Cauchy to Weierstrass meant a cognitive emancipation process from ideas that have roots at the deepest mental levels. In my opinion the men who carried it out deserve our gratitude and enthusiasm, although those roots were not all eliminated.

There is no need for women to feel left out as a consequence of *that* cultural development. I want women at the universities pondering their differentials and integrals to be able to experience it as an intellectual feast - not because of any godlike abstractness inherent in the theory, but precisely because of its restructuring as a non-mythical, non-mysterious instrument allowing the construction of useful things while encouraging discussion about claims to their practical worth.

7. Fourth example: Good-bye to isolated individuals

7.1. *Shift to relational!* Philo's use of the categories Male and Female depended on an anthropology, still much alive and operative, that deals with "the" Male, "the" Female, as such and such a *character type*, and that in theory describes any individual male and any individual female by his or her similarity to a so-called genus, "the Male" or "the Female", that epitomizes this "character". An anthropology that judges every individual male or female one at a time, and that hence recommends an official logic (e.g., Aristotle's logic) that can deal only with such one-by-one judgement. Direct comparison is then comprehended only as between one individual and a genus or character type, never as a straightforward comparison of two or more individuals.

What is called modern logic is found nowadays (with exceptions) in the heart of the exact sciences, most of the natural sciences and, though unknown to great parts of practical life, in increasing measure also in the social sciences. It encourages you to compare two or more individual things in the empirical world - humans, forces, or whatever - directly with one another, without a detour via "genera". This feminists, at least, ought not to disregard, for it can be put to work so as to obtain a tremendous practical import.

7.2. *Strategical serendipity: Good-bye to judgement by Character!* Let me mention one extremely important field of judgment where norms issuing from older logical habits are still taken for granted and new norms are called for. This is the evaluation of candidates for academic and other appointments, when some of these candidates are women. I do not have the time or space to sketch the norms that are commonly in use and confine myself to a formulation of a new norm, a "counter-norm" compatible with theoretical academic logic in the twentieth century.

Counter-norm No. 1 (for members of appointment committees, for positions at any level, wherever:)

Do not ask whether a woman *has undesirable personal qualities (traits, characteristics)*.³³

Stronger still, don't ask whether she has "properties".

Instead, do this: first read, or re-read, in case your committee will also have to judge the qualifications of women, Elaine Showalter's book *The Female Malady*. Then you may begin to understand something also of the situation of women on the labour market and in our time.

Thereafter, ask only whether the woman concerned unquestionably *has displayed even worse behaviour than X (has behaved even more dishonestly than X, even more deviously, shyly, or brazenly, or looks more power-driven, or whether she would be an even worse Manager/Director/Dean of Faculty, than X)*, where as values of *X* one successively takes the names of the five most impossible and regretted men employed in the department.

Never ask, and never respond to a question whether a particular woman is "suitable for a directorship/professorial chair", or similar questions. Ask and respond only to the question whether this individual woman is **as suitable as the least capable** male director/professor was at the moment of his appointment in your corporation or faculty.

[If you have ever used or are unwilling to completely abstain from thinking in terms of "character" and "traits":

Encourage the empirical study of so-called *character features (traits), uses of language, managerial style, and other "personal features"* of **each male employee**, of all ranks, in all economic sectors that you are able to affect. Carefully investigate how they *de facto* have spoken and acted on local and national boards and committees. Investigate whether the minutes are in principle traceable and findable; if they are not, the faculty in question is to suffer a serious budgetary cut. The Ministry of Science and Education

should contribute a rather large sum in order for this research to get a good start.]

Further the appointment to full professor of every woman with a doctorate who might so wish, *provided her scientific production is no worse than that of the least talented man when he was employed in that rank.* And make similar formulations for other ranks and industries.

The second of the strategies I recommend is to work towards the acceptance of the logic of **comparative over-all evaluation**, or, "**better-than-the-worst**" **evaluation**, as defined by Counter-norm No. 1, and to see to it that a norm more or less like No. 1 is incorporated into our employment culture for as long as women are not as strongly represented as men.

8. Whose textbooks?

Such things I believe to be of importance to each woman student. But then there is the question of who writes the text-books. Is it encouraging to female students that they are *all* written by men? This I don't believe, however excellent many of their books may be. There ought to be some exceptions (at least). So my third strategy recommendation is: see to it that there are some exceptions. But how to find them?

This is a question that in my opinion deserves much, much more attention.³⁴

¹ Bold letters are used for terms that function as technical terms in this paper. Italics as usual.

² Cf. Walter J. Ong, **Fighting For Life: Contest, Sexuality, and Consciousness**, Cornell U.P., 1981

³ Which, it seems to me, is backed by Nancy Chodorow, Walter J. Ong and several others (including myself).

⁴ A communicative ("dialectical") field concept is developed, with due reference to Kurt Lewin, in: E.M. Barth, **Dialectical fields and transformations: Brouwer fields, Beth fields, and Naess transformations**, *Philosophia Naturalis* 21 No. 2-4, 425-34.

⁵ In Practice, "pure" - as in "pure mathematics" - may seem to mean: not aimed at direct applicability. Emotionally, however, it seems to mean "at a distance from the space inhabited/inhabitable also by the other sex". - For an illustration, see the low value assigned to civil engineering in **Leven, Kunst en Mystiek (Life, Art, and Mysticism)** by the Dutch misogynist L.E.J. Brouwer (1905).

⁶ It seems to me that this existential need and its solution will be involved in all educational measurements of interests and proficiency, somewhat like cosmic noise in many parts of physics.

⁷ Cf. Section 6.3 below.

⁸ Vladimir Nabokov, Berlin 1930, in Russian; the title translates as **Lushin's Defense**. First complete English book edition: **The Defense**, 1964.

⁹ And of course into political science as well, but that is - perhaps? - another topic.

¹⁰ Barring those who suffer from Anorexia nervosa (if my hypothesis in Section 6 turns out to be correct).

¹¹ More precisely, within a *monadic* logic with an associated metaphysical theory of values.

¹² Richard A. Baer, **Philo's Use of the Categories Male and Female**, 1970.

¹³ For example, "Philo's use of the categories male and female in reference to Areté, Sophia, and the Logos is purely functional, never ontological" (p. 66). In other words, he does not mean to say that Areté, Sophia and Logos *are* females or males. "Rather, they are thought of as male or female only in terms of their functioning as active and dominant, in which case they are considered male, or passive and receptive, in which case they are described as female. Therefore to speak of Sophia or Areté as androgynous is misleading. At this point Philo differs substantially from most of the Gnostics. For Philo, the categories Male and Female function *within* the realm of creation" (l.c.).

¹⁴ See Below.

¹⁵ In fact, none of the men dared to say anything whatsoever, not even my best friends and colleagues. It was before such things could be spoken about without painful embarrassment. The only philosophy colleague who reacted to that inaugural lecture at all was Professor C.W. (Cornelia) de Vogel, in classical philosophy, who regretted my not having mentioned the sexism of G.W.F. Hegel.

¹⁶ F.M. Cornford, **From Religion to Philosophy - A Study in the Origins of Western Speculation**, 1957 (1912): "Sex the prototype of Contrariety", p. 65-72.

¹⁷ Ernst Topitsch, **Die Voraussetzungen der Transzendenz-philosophie**, 1975.

¹⁸ Thomas Laqueur, **Making Sex - Body and Gender From the Greeks to Freud**, Harvard University Press 1990. The title means: forming the concept, or concepts, of "the sexes".

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¹⁹ The disappearance from the *logic* of modern science of this hierarchical way of bringing about conceptual connectedness seems to be part of what has inspired Carolyn Merchant to her book **The Death of Nature - Women, Ecology and the Scientific Revolution**, 1980. My thanks are due to Renée José Dalitz for bringing this (strange) book to my attention.

²⁰ L. Nelson, **Sämtliche Werke VII: Fortschritte und Rückschritte der Philosophie**, posthumous publication ed. by J. Draft, 1962. Hans Lenk, **Kritik der logischen Konstanten**, 1968, p. 196f, 213f.

²¹ The use of truth values, and of flip-flop representation in electronical data representation, is another matter entirely. We have been talking here of logical representations of the object fields of the sciences (and the humanities), the immediate descriptions of "what there is", in natural or in mathematical languages. I mention this on account of a remark made after my talk by one of the participants.

²² Hannelore Schröder, **Die Rechtlosigkeit der Frau im Rechtsstaat**, 1975.

²³ Fichte's antisemitism could be added; see Paul Lawrence Rose, **Revolutionary Antisemitism in Germany - from Kant to Wagner**, Princeton University Press 1990.

²⁴ Walter P. van Stigt, **Brouwer's Intuitionism**, North-Holland (Elsevier Science Publishers B.V.) 1990; p.149, 305.

²⁵ From: **Women Philosophers Through 1990** (note34).

²⁶ Cf. books by G. Jacoby; B. Baron van Freytag; Carl Schmitt (see note 31).

²⁷ There are papers on this by Dutch art historians Elly Cassee and Sam Dresden.

²⁸ There are some exceptions. As A. Robinson has shown, it is possible to define a concept (say, "Neo-Infinitesimal") in abstract model theory and to use it in a way that has some - though by far not all - features in common with that of the old notion, without running into contradiction. However, that approach is not needed for anything in particular or otherwise particularly valuable, so that even today the term is superfluous.

²⁹ "And hasn't Abraham Robinson showed ..." (and so on). No, he didn't - he did *not* inaugurate a return to the category of Seed as a category for power and potency. He dealt in mathematical model theory, and that is not the same. Force and energy still are physical categories.

³⁰ This is of course not meant to suggest that this instrument is a panacea for all disagreements and conflicts, which would clearly be a quite preposterous claim. Many additional instruments are needed.

³¹ See for instance Nicolaus Sombarts mesmerizing study **Die deutschen Männer und ihre Feinde: Carl Schmitt - ein deutsches Schicksal zwischen Männerbund und Matriarchatsmythos**, Carl Hanser Verlag, Munich/Vienna, 1990.

³² Weird as this theory may seem today, it is, I would think, amenable to empirical exploration by cognitive psychologists.

³³ See the keynote paper by E. Kvande, this conference (manuscript, p.3), on "the 'trait' approach" - "where certain *characteristics* of managers are seen as an important element of leadership theory".

³⁴ As to philosophy, information enabling teachers to compose new programs for students may be found in my **Women Philosophers - A Bibliography of Books Through 1990**, Philosophy Documentation Center, Bowling Green, Ohio, 1992. In addition to ethics, epistemology, logic, metaphysics and so on the bibliography includes also the philosophy of mathematics, of cosmology, and of the physical sciences.

A DECADE OF CONCERN: THE GASAT EXPERIENCE

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Rector, GASAT colleagues and friends: I am honoured that you asked me to speak here at the University of Technology, Eindhoven, on the topic 'A Decade of Concern: the GASAT Experience', for it was ten years ago that I was here in Eindhoven, helping to put together the report of the first GASAT conference. But you have set me a difficult task. Ilya Mottier orientated our thinking skilfully and comprehensively at the beginning of this conference by raising questions from that experience. We have since spent two days of intensive listening and discussing on selective issues. Perhaps it will be of value to reflect once more on the dimensions of the problem we are addressing.

The GASAT conferences are a product of the 1980s. On the one hand the twentieth century women's movement had focused attention on equality of opportunities in the widest sense; we were in the middle of a UN Decade for Women and one by one countries were introducing some form of equality legislation. On the other hand, in the West, science educators were left in no doubt of the unpopularity of science, especially physics, as young people, many males as well as most females, avoided their study as soon as they had the choice. Added to these concerns were those of industry and governments over the shortage of skilled personnel; these last factors favoured funding of intervention projects.

A number of people, in various parts of the world, had taken initiatives to encourage more girls to study science. The first conference to bring such people together was made possible, in 1981, by a generous grant from the Dutch Government. It was held in Eindhoven and coordinated from the Technical University by Professor Jan Raat, assisted by Ilya Mottier, from the Ministry of Education and myself, from the UK.

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GASAT then stood for Girls and Science and Technology. Papers submitted for the conference focused largely, but not exclusively, on girls' experiences of science and how these related to later participation (or lack of it) in science and technology careers.

How was the problem perceived? We challenged the easy assumption that girls were the problem - that they needed only to be better informed and more effectively counselled to choose science and its related careers. You will see, if you have access to the reported 'Proceedings' of that conference, that the complexity of the problem was already apparent. Three interacting sets of factors, influencing how it was with girls in science and technology in any one time and place, were identified: the philosophy, aims and organisation of education; the expectations that a society has of its men and

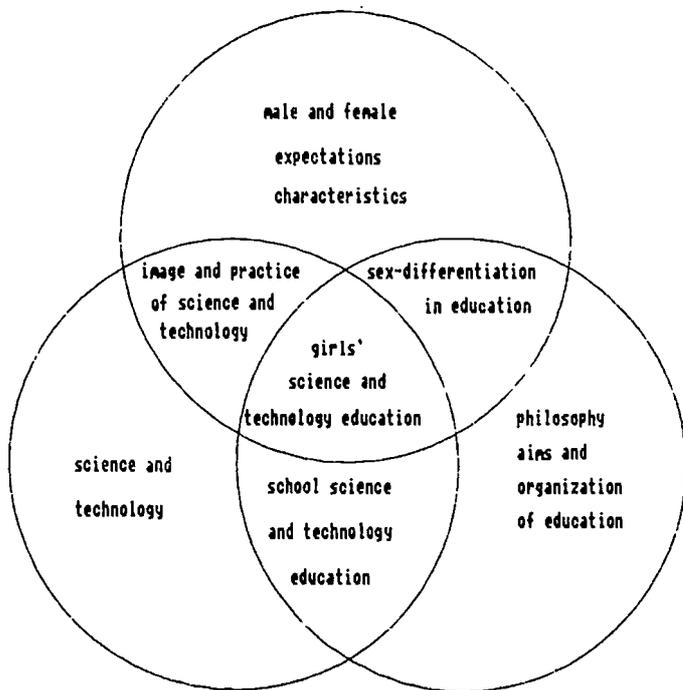


Figure 1: Interacting factors in girls' science and technology education

women, girls and boys, and the characteristics they develop, and the perceived roles and the practice of science and technology in the world, and the manner of their presentation for learning (see figure 1).

I will expand a little on these three groups of factors, drawing upon the inputs to GASAT Conferences. I will have to be very selective: there have been around 500 papers prepared for GASAT Conferences and in no way could I attempt to do justice to the richness and variety of understanding of, and approaches to, the problem that they contain.

Taking the school system first, we recognised the consequences of differences both for our perception of the problem and what intervention was appropriate. For example, in Western Europe access to many higher level education courses, and professions, require high level school qualifications in physics, whereas in the US a college entrant could begin the serious study of physics, provided she or he had an appropriate grounding in mathematics. Hence the concern, in the US, for women and mathematics and the many interventions at the tertiary level and in informal education to orientate young women to science. In the UK, the failure to choose physics at age 14 formed an effective barrier to many professions. Our concern that all young people should follow 'a broad and balanced science course' has been incorporated into the National Curriculum in the UK, but, since it is still possible to choose between doing one or doing two units of science between the ages of 14 and 16, we still have to monitor for the consequences of this choice.

Evidence came from Norway (Skog, 1983) and Australia (Parker, 1987) that when greater choice was introduced, sex-stereotyping increased. On the other hand, it was reported from Thailand, where all young people have to study some science to the age of 18 (and those who choose the science line all follow the same physics, chemistry, biology and mathematics courses) that girls do as well as, if not better than, boys (Klainin et al. 1987). We hear from our Eastern European colleagues, at this conference, that similar conditions have existed in their countries.

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Secondly, in most societies, sex stereotyping of qualities, values and activities carries with it a heavy historical weight. Equality policies may be published by governments, employers and education departments, but expectations are slow to change. Moreover, as Gunn Imsen (1985) reminded us, at GASAT 3, the rhetoric may be changing but patriarchy is alive and well and flourishing in the modern world. We see it in the predominance of males in government, in senior personnel of institutions, and in the persistence of structures and processes derived to match men's life patterns and needs in fields that are now nominally declared open to women. Wagner(1985) reported the ambivalence generated in young women starting out in technical employment: they were proud of the skills they were developing, but troubled by the masculine persona they were required to adopt.

Problems arise in programmes conceived as more 'liberal': we wish to provide freedom of choice and to encourage young people to exercise decision-making skills, but if sex-stereotyping exists in any form within the society this will exert a pressure on the choices made. A paradox then arises: to give greater freedom later, we may need to limit earlier educational choices.

Thirdly, we turn to the image and practice of science and technology. How is science perceived at school level? Young children drew scientists as men (Simpson and Girdham, 1987), girls reported much less time spent with science-related toys and activities out of school than did boys (Rennie, 1987) and this could correlate with a lesser success in related formal science in school (Lie and Bryhni, 1983). Science (and especially physics) was seen as difficult, masculine, abstract and unrelated to everyday life.

Intervention projects, such as GIST (Girls into Science and Technology) (Smail, 1983), MENT (Meisjes, Natuurkunde, Techniek) (Raat, 1981) set out to change this, and girls' involvement, by relating science to girls' interests and experiences as well as boys', in particular science was related to the social context. The McClintock Collective in Australia explored the

use of drama, role play and creative writing in presenting and recording science. (Hildebrand, 1989) In a Danish project young people were encouraged to recall any links to previous experience when faced with a new topic and to explore the feelings it aroused for them. (Vedelsby, 1987). Most projects worked with teachers, both to extend their understanding of the problem and to develop skills in presenting science differently.

We have learned that intervention is most effective if sponsored by senior personnel and supported by grass roots commitment. In spite of the complexity of factors operating on the choice of science, some careful researches have attempted to generate models to guide intervention. Hildebrand (1987) put forward an early model; another, developed alongside the MENT project, was presented by Alting (1991) at Melbourne and Eccles (1992) has presented her model, developed in the US, at this conference. All emphasise the multiplicity of factors involved and, by implication, the risk of failure if intervention addresses only one factor.

Technology education is particularly problematic. GASAT 1 focused attention on the negative image children in Sweden had of technology (Lindholm, 1981); they drew pictures of devastation, with people fleeing from the picture. The PATT project has further investigated attitudes and made recommendations for curricula (de Klerk Wolters et al, 1987). One problem has been the association of technology with earlier workshop-based craft subjects used almost exclusively for boys. Home economics has not so readily been accepted as technology although (Mottier, 1985) described attempts to integrate home economics into technology education in the Netherlands, and Sweden has done this for many years.

The present uncertainty about technology in the National Curriculum in the UK is partly caused by the failure of the Engineering Council to recognise a 'home economics' contribution to technology education. Even some who support its place do so because they see it will provide something for the girls to do!

More positively, everyday technology has been used as a vehicle to empower women who have missed out on earlier science and technology education. AnnMarie Israelsson's development of the Tekinkens Hus in Luleå has been an exciting project to follow for GASAT participants, who rejoiced with her over its opening in 1988 (Israelsson & Nordell, 1990) * Harding, J. (1992) has used the technology of fabrics and their care to develop some understanding of basic chemistry with rural women in the UK.

All aspects of technology education, whether directed towards technological awareness, literacy or capability, have gender interactions which will need to be addressed.

Engineering education has featured strongly in GASAT conferences. A number of projects encouraging young women into engineering education and supporting them there have been reported (Daniels, 1987; de Raaff, 1981). The entry of older women has also been facilitated. (Anderson, 1983, 1989, Chivers and Swarbrick, 1985 and Swarbrick, 1991). A network linking projects in the US has been established, WEPAN, with a proposal to extend internationally.

But we have asked why?, why are we concerned to get women into science and technology? Are we responding only to the skills shortage syndrome? If so, we are right to be suspicious, as Ilya warned us to be, for women may be the first to be rejected when the shortage has been made good.

There are positive reasons, for women themselves, to consider in the two areas of living and working. Where women feel alienated from science and technology they also experience alienation within a culture increasingly dominated by these fields. It becomes a mental health problem for them. Additionally they lack the confidence to contribute, in a democracy, to decision making about developments in science and technology. They become second-class citizens. We need to reclaim science and technology for 'ordinary' women.

* (see also the workshop report in this volume)

There are also positive arguments for wanting more women to work as scientists and technologists. These relate to financial advantage for women, advantages for science itself and for the impact of technology on the world.

Where well-paid work exists for those with skills in science and technology it is not morally right that women are excluded from this work by differential expectations and sex-stereotyping. This is an important argument in the US and is used against protective legislation specifically for women. If work is hazardous, then people, both men and women, may need protective legislation.

The advantages to science and to the world arises from a consideration of values. Modern science has developed within cultures in which different values, roles and expectations are mapped onto men and women. Men are expected to be ambitious, to develop leadership, autonomy, dominance and control. Abstraction and so-called objectivity are characteristics of their thinking. On the other hand, women are expected to be nurturant, and submissive. The nurturant role enables women to be in touch with many more aspects of the social and physical environment. They appear to be more tolerant of ambiguity and less readily disregard context. I believe the practice of nurturance generates humility, a characteristic absent from the expected behaviour of men.

Because men have formed the majority of persons involved in the development of science and technology, the values and characteristics mapped on to women are not strongly represented in their practice.

The nature of engineering education and the values embodied in it has been questioned insistently in Denmark (Kolmos, 1987, 1991) and further explored via a symposium at GASAT 6. The whole thrust of the first Euro GASAT Conference, held in Denmark in 1986, was 'Women Challenge Technology'.

At GASAT 4 our attention was drawn to the writings of Evelyn Fox Keller on gender and science. Her analysis of modern science as masculine

focuses on not only its historical origins, but also the creation of male-ness in men through nurturing and expectations (Keller, 1986). She suggests that this process generates specific emotional and cognitive characteristics which interact with the practice of science. One such characteristic is the need to be in control and may lead, she suggests, to the dominance of 'master molecule' theories in biological systems and an inability to tolerate ambiguity which leaves unresolved the nature of electromagnetic radiation. Could science be different if more women were involved? Else Barth, on Monday, presented a similar analysis in the fields of mathematics and logic.

Questions relating to the possibility of a feminist science were considered at GASAT 6:

-do women practise science in a different way? Fox Keller uses the life and work of Nobel Prize Winner, Barbara McClintock, to illustrate her argument (Keller, 1983). McClintock, herself, denied she worked differently, but Keller claims she was able to 'see' the transportation of genetic material in the 1950s precisely because she was a woman, unwelcome, at the time, within mainstream science so that she escaped socialization into male ways of thinking and could use individual-istic methods of enquiry. These happened to be nurturant, showing humility in the face of the material she studied. She used phrases such as 'let the material speak to you', 'let the material tell you what to do'.

At GASAT 6 we heard from a woman professor who had her own research programme, in a Canadian University, in the field of forest genetics. She told us she was closing her research laboratory as she could no longer identify with the mores and ways of working in the field. The major thrust in forest genetics has become 'how to improve trees'. She rejected the arrogance of this position.

These women were bringing different values to bear in the practice of science. They were perhaps generating knowledge in a way different from that in the dominant, masculine ideology.

-is there a feminist science? Sandra Harding fails to identify such a science. but in a paper enquiring into 'feminist methodology' (Harding, S. 1989) identifies three characteristics of 'good' feminist research: use of gender as an analytical tool (using the gender lens); recognition of women's experience as valid evidence in scientific research; and use of a robust gender-sensitive reflexivity.

-is a feminist science a desirable/valid objective? We may accept the analysis of modern science as masculine and see it as a distortion, constraining science. Would a 'feminist science' create a similar distortion?

-should we aim (as McClintock and Keller prefer) for a science in which the question of gender drops away?

Whatever emerges from this questioning it is essential that we go on using gender as an analytical tool as we work within science and technology, attempting to understand and to improve the position of women.

It is not surprising, therefore, that at GASAT 4, a decision was taken to replace the 'G' for 'Girls' by the 'G' for 'Gender'. Also at GASAT 4 we resolved to move towards a more formal organization of an association. This has taken time, but at GASAT 6 a constitution and objectives were agreed, members paid their dues and a mechanism was put in place to elect the first GASAT Association Board.

So what is the future role and direction of GASAT? I hope that we will continue to operate as a network exploring common problems within differing contexts; that we will continue to provide mutual support for those with the temerity to challenge a world order still framed and operated to male priorities. This I see as a feminist task and men as well as women can be feminists.

We will survive only as long as members find an Association useful and have the resources to come together for conferences. International conferences are costly not only for organisers but also for participants and although we are grateful to the sponsors who have given generously to this

conference. we are sadly disappointed that we were not able to bring to Eindhoven more of the women from East Europe who wished to attend. The other resource is people's time and commitment. We are indebted always, to the people who undertake to organise a GASAT conference and to the institution that supports them. We express a deep appreciation for the commitment of Marijka, Marja and Anita and their team and for the back-up given by Eindhoven University of Technology.

There will, no doubt, be a proliferation of groups concerned with specialist areas, such as WEPAN, which focuses on programmes encouraging and supporting women in engineering education. We hope they will retain contact with us. Some of you will know that I take an eclectic view, urging that we learn from each others' perspectives to generate a more holistic understanding of issues.

We have a recurrent problem - that of language. English has been the working language of all GASAT conferences and as one for whom English is the mother tongue I am humbled by the fluency shown by those of you who have different first languages. But it has been a major barrier to communication and participation from Southern Europe, including France; we are the poorer for it. A French feminist perspective of 'vive la difference' would make an interesting contribution to the debate on 'a science in which the question of gender drops away.'

Within the European Community language differences are met with simultaneous translations, but this requires expensive technology and skilled personnel. Perhaps one day we will become so valued in Europe that we are given access to these aids!

But we have a great opportunity next year at GASAT 7. Because of the special historical background to Eastern Canada many Canadians are bilingual in French and English. We hope that a number of French-speakers will come to Canada. If you know of any working in the GASAT field, persuade them to attend the conference. I am taking French conversation classes throughout this winter, especially to benefit from their presence!

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STRUCTURES - POLITICS - CULTURES UNDERSTANDING THE GENDERING OF ORGANIZATIONS

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Abstract

This article presents a study of female graduate engineers entering male dominated organizations and management positions. The individual perspective used in most of the previous studies in the Women in Management tradition is criticized and a structural approach is developed. The main data come from case studies in six large Norwegian companies where pairs of comparable male and female graduate engineers were selected. The study shows how the difference in organizational structures is the main explanatory factor for the differences in opportunities for careers. A second stage of the argument juxtaposes these results with Kanter's (1989) and Clegg's (1990) studies of new organizational forms. The results of the study are used to develop a differentiated understanding of gender in organizations using feminist theories on how to conceptualize gender combined with different theoretical perspectives from organization studies.

Keywords:

women's opportunities
gender studies
organization theory
de-hierarchization

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STRUCTURES - POLITICS - CULTURES. UNDERSTANDING THE GENDERING OF ORGANIZATIONS.

Introduction

Organization studies as a field has been criticised for having neglected to include gender in its analyses, or, when gender is introduced, for an inadequate analysis of it (Mills 1983, Hearn & Parkin 1987). Gender in organization has until recently been treated only indirectly, either as part of Women in Management research (WIM) (Henning & Jardim 1978, Donell & Hall 1980, Marshall 1984) or as part of women and work research (Kaul & Lie 1982, Cockburn 1983, 1985, 1991, Knights & Wilmott 1986). At the same time it is fair to say that organization theory and organization research has not, until recently, been addressed in feminist research. Thus organization studies needs to confront the gender issue and gender studies needs to put organizations on its research agenda (Kvande & Rasmussen 1990). Organizations are, after all, the area where the sex-segregation of the labour market, the unequal distribution of rewards as well as gendered cultural images and identities are created (Acker 1990). We can now observe a move from studies focusing only on women in management to studies exploring gender in organizations. Studies are emerging where a more comprehensive understanding of gender and organization is being developed (Kvande & Rasmussen 1990, Calas & Smircich 1989, 1990, Acker 1990, Alvesson & Billing 1992). Our article is a

contribution to this development.

Our point of departure is a research project on Norwegian male and female engineers and their career development in different work organizations. We wanted to examine opportunities for career development, graduate engineers being one of the main groups who are recruited into management positions in Norwegian industry. Between 1979 and 1985 the ratio of women at the Technical University of Norway had increased from 5% to 25-30% and has stayed there since. These changes mirror the general changes in women's relation to work and their participation in society in general in Norway where 75% of the women work and 60% of them work full-time.

We will develop our understanding of gender in organizations in a dialogue with this empirical material. In this dialogue we will use two strands of theorizing. One strand concerns the different ways of understanding and analyzing gender that have been developed in feminist research (Harding 1986, Calas & Smircich 1989). The other strand involves the different theories that have been developed in organization studies. By combining the two strands we will show how this "marriage" between feminist theories and organization theories enables us to develop a differentiated understanding of gender in organization.

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From Women in Management to Women in Organizations.

The main field in research aimed at understanding women in organizations has been the Women in Management (WIM) literature which was mainly developed from the mid-seventies in the USA. A common trait of the WIM literature is the focus on individual characteristics of women, in the light of sex socialization and gender roles (Donell & Hall 1980, Powell 1989). Research on women in management, such as female graduate engineers, mainly uses a sex role model approach attaching importance to socialization. In such research much emphasis has been put on women's lack of self-confidence and ambition in order to answer the "why so few" question, which is the typical research question in this tradition (Terborg 1977a, Donell & Hall 1980).

We have structured the studies in this research tradition in the following four categories:

- 1) The "trait" approach, where the main emphasis is whether women are "suited" to management.*
- 2) The "motivation" approach, with the focus on women's "lack of" self-confidence or motivation.*
- 3) The "strategy" approach, where the emphasis is on whether or not women are good enough strategists, making use of the right informal channels.*
- 4) The "choice" approach, showing that women choose to give priority to their home and family rather than a career.*

The "trait" approach, is part of an Anglo-American tradition of research where certain characteristics of managers are seen as an important element of leadership theory (Yukl 1981). It is used as a basis for evaluating how far women "are suited" to leadership or whether they represent "deviant" values opposed to the traditional norms and values associated with management (Bartol 1978, Donell & Hall 1980). Terborg (1977b) says of the studies in the trait tradition: "In general women are perceived as being dependent, passive and subjective, and as lacking such attributes as competitiveness, ambition and leadership abilities".

The "motivation" approach is based on the idea that women uphold traditional women's jobs because they lack motivation and self-confidence; they score lower than men on these variables (Terborg 1977b, Hackett & Betz 1981). According to this view, women will try to avoid success because it can have negative consequences, such as loss of femininity and social recognition. They have a fear of success (Homer 1972). However, later research indicates that the so-called "motivation" reflects cultural stereotypes of male and female areas of achievement and of work (Nieva & Gutek 1981). Hackett & Betz (1981) maintain that it is natural to assume that women's work expectations will be lower than men's in a number of areas because women's chances have been and still are very poor in many areas.

In the "strategy" tradition Henning & Jardim (1978) with their book "The Managerial Women" are the main representatives. According to Henning and Jardim, men and women have different ideas of the concept of "career". Women define career in terms of personal growth and self-realization. Men are more likely to see career as

a series of jobs leading upwards providing status and recognition. Because of these different concepts, women are not aware of the informal network of connections which men have and use in their careers. This "hidden" system has a great deal of influence on the way work is organized, and until women learn to use it as men do they will be starting with a serious "handicap" in their way to the top, according to this view.

The "choice" approach emphasizes women's "choice" or giving priority to home and family as the explanation of why there are so few women in non-traditional jobs and in management, and this is the predominant approach of the four. It is supported by studies showing that relatively few of the women who make a career in public or private business are married compared to the corresponding group of men (Hemes 1982). This is stressed particularly in surveys among American women in management positions (Henning & Jardim 1978, Business Week 1987). However, research from USA and the UK indicate that women in top positions now are integrating the role of mother with that of manager (Epstein 1983, Marshall 1984). A number of research reports have appeared pointing out that there may well be many advantages for married working women over the unmarried ones (Reskin 1978, Lukkonen-Groow & Stolte Heiskanen 1983, Marshall 84, Kvande & Rasmussen 1990).

A common denominator of the four categories presented is that they refer to characteristics of the individual rather than factors related to the work-conditions offered to men and women by the organizations where they work. The alternative

to this individual focus is to attach more importance to structural conditions in the work-organizations where women work than to individual characteristics of women (Acker & Van Houten 1974, Kanter 1977, Epstein 1981, Kvande & Rasmussen 1989, 1990).

An example of such an approach is given by Rosabeth Moss Kanter (1977). She shows how the structural conditions in a large corporation limit women's opportunities. Kanter's approach must be read as a criticism of individual-oriented explanations. Women's positions in the labour market are on the lower levels of the corporate hierarchy with limited opportunities for mobility. According to Kanter (1977) it is therefore unreasonable to conclude that women limit their career aspirations because of their sex-roles or family. She presents an alternative structural model which involves the structure of opportunity (meaning the challenges available, the chances of learning new skills and the earning of organizational rewards); the power (i.e. ability to get things done), and the social composition of groups (here meaning the relative number of women in work groups and departments).

The third structural variable, the social composition of groups, is considered to be her most original contribution. Here she focuses on the importance of the relative number of representatives of different social groups in a workplace. The situation is very different if there is only one woman, some women, a minority group of reasonable size or a balanced group of men and women. If women are alone or only in a small minority, they will be seen by the majority as "tokens" or symbols of

their group and not as individuals (Kanter 1977). Kanter has been criticised for the gender-neutrality implied in the relative number position (Fairhurst & Snavelly 1983, Ott 1989, Kvande & Rasmussen 1990).

Our main critique of Kanter, however, is that she studied only one company, with a traditional hierarchic structure. Therefore she does not take into account that different types of organizations may involve different structures of opportunity for the employees. Like most organization researchers she understands the bureaucratic and hierarchical structure of organizations as the structure of "modern" organizations (Clegg 1990).

Kanter represents a move from the traditional management research in organization studies as she focuses on organization members at many levels, and our structural perspective is inspired by this as well as by the Scandinavian sociotechnical work research in the work-democracy tradition (Emery & Thorsrud 1969, Herbst 1976). In this tradition we are especially interested in alternatives to hierarchies and in variations in organizational structures in order to test the hypothesis that organizations vary in opportunity structures.

Method

Our structural approach to male and female graduate engineers' careers and development led us to choose a qualitative method in our study. We needed information about the structural conditions of the organizations, the individual characteristics of the engineers and the processes of gender differentiation within the organizations. With these needs in mind three different data-sets were employed.

- First case studies were carried out of six large Norwegian companies that employed many graduate engineers, and more than ten female graduate engineers. By varying ownership (public and private), branches (chemical industry, electronics, oil, construction, research and development), new and old businesses, employing different types of graduate engineers and having affirmative action for women or not, we wanted to cover differences in structural conditions. These variations would also make an analytic or substantial generalization possible (Yin 1984).*

Within each of the firms we carried out in-depth interviews with pairs of graduate engineers: one male and one female engineer who graduated the same year and were employed within the same department. Through our selection of pairs from the different firms we could compare men and women across the firms and within the firms. We made in-depth interviews with 26 pairs of graduate engineers in the six companies. We also interviewed the managers of the pairs and key informants

about market, organization and personnel policy.

Secondly, we carried out a postal survey of all female members of the Norwegian Engineering Society, asking questions about their work and work experience, career and career plans, management, family and housework.

The third and final data set comprised a national survey with structured questions of all groups of female academics concentrating on the themes of work and family. From this data set we selected the responses from women educated at the Technical University.

Our study is reported in a book that discusses all our findings around work, careers, family and individual strategies and differences among women and men. In this article we will draw mainly upon the six case studies. We will, however, in also use some of our findings from the two surveys.

Different organizations - different opportunities.

The inadequacy of an individual explanation for women's lack of participation in management, was confirmed in our study. Our surveys showed that the female graduate engineers were motivated for careers without sacrificing a family. When asked whether or not they would take a management position when offered, 70% of them said that they would. The highest motivation we found among the mothers

of one child (82%), and the lowest among the mothers of three or more children (63%). We also found that the female graduate engineers were more often married and had more children than Norwegian women in general. The female graduate engineers wanted to combine family and career (Kvande & Rasmussen 1990, chapter 5).

Studying different types of organizations turned out to be very important in our study of female graduate engineers. We had expected to find that the women had the same, equally unfavourable, opportunities in all the firms. However, we found that there were greater variations between the employees in different firms than between the male and the female graduate engineers in our sample as a whole.

We found that the six companies could be divided into two main groups. Two of the companies showed no systematic differences in opportunities for career and development between male and female graduate engineers. The other four showed a traditional pattern of gendered differences in opportunities: the male engineers had systematically better opportunities than their comparable female colleagues.

There are some striking differences in organizational structure between the "equal opportunity" companies and the others. We have isolated characteristics of the two different types of organization in order to study them as ideal types. These ideal types serve as a reference point against which the individual companies can be measured. The companies where we find that men have systematically better opportunities than women, are characterized by a hierarchical organization

structure and they operate within stable markets. The companies where opportunities do not vary systematically according to gender are characterized by a less hierarchical and more flexible network-type of organization and they operate within turbulent and changing markets. We labelled the two types static hierarchies and dynamic networks. The dynamic networks we found in the telecommunications and electronics industry and in engineering (construction of oil installations). The static hierarchies we found in an oil company, the chemical industry, research and development and public telecommunications.

By looking at variations in organizational structure we take a step further than former studies of women and organizations where the hierarchical bureaucratic organization has been treated as the dominant modern organization (Kanter 1977, Ferguson 1984, Ressler 1986). Thereby the researchers have been able to maintain the view that organization structures are gender-neutral and that the gendering occurs through a separate structure or process, like patriarchy, as Acker notes (Acker 1989). Our results show how different organization structures are gendered differently.

Our results do not confirm the common belief in the social democratic Scandinavian cultures, that public organizations further women's careers whereas private organizations do not. This belief is built mainly upon a weberian logic that within public bureaucracies the impersonal rules and regulations will hinder discrimination and arbitrary treatment of women. In private organizations the subjective views of (male) managers are supposed to exclude women from

important jobs and positions. This belief in the objective functioning of rules and regulations in organizations has been a cornerstone of the equal opportunity policy in the Scandinavian societies (Hernes 1982). Our results seriously challenge this belief.

We shall explain the differences in opportunities for men and women in the two types of organizations by discussing some of their characteristics. Dynamic networks are open to innovation and change whereas static hierarchies are status quo-organizations. The dynamic networks make women visible as professionals and provide leadership training whereas the static hierarchies make women invisible as professionals and promote homosocial reproduction in management. These characteristics are discussed in turn below.

Dynamic Networks.

We found that the organizations with no systematic differences in opportunities between male and female graduate engineers were the ones where the market was turbulent and required an organization structure which was very flexible and open towards new approaches. These companies have had to be dynamic; they have profited from trying out new ideas and non-traditional approaches. This in turn has created a corporate culture which welcomes change and new ways of doing things, including trying out women in non-traditional positions. They have a fundamental openness towards change. The hard competition forces them to use

all their resources. One of the women in a dynamic network organization said:

"I'm surprised at the opportunities we have here. There is room for new ways of thinking in the organization. It doesn't have a fixed structure but has to keep alert and be innovative all the time. It has to follow the signs of the times. I think this is what makes it more open to taking on women and giving us opportunities."

The power structure in network organizations strengthens the dynamic aspect. The decentralized structure is based on the idea that everyone who has relevant knowledge for the problem in question is involved in decision-making. Different ways of thinking, values and opinions represent a resource for interpreting signals from the market and the environment and in working out solutions to new challenges. Women and their points of view are seen as a resource for the organization.

In dynamic networks the work is organized in teams where all members are equally important and all contribute knowledge and effort on an equal basis. As they work, the graduate engineers get to know each other's academic and personal qualifications. The women become visible as professionals for their colleagues and superiors.

The organization of tasks is flexible in the dynamic networks. The employees here do not have clearly defined tasks and areas of responsibility, but their tasks and

responsibility alter progressively as the situation changes. The employees are given responsibility and challenges whether they want them or not. One of the women said:

"What I don't like is never having time enough to follow up all the challenges in the job, at least not in a normal working day".

A female manager told us how she solved the pressure between having a family and a demanding job:

"I am known as one who use flexitime in the extreme. I have done it the way I want, and it has been accepted. Maximum flexitime is an important condition in my life. The kids decide the tempo in the morning. When I get to my job, I work hard. I like it that way."

In dynamic networks the engineers get a gradual training for leadership through their work, and this seems to suit women well. It also makes it easier for women to volunteer for new tasks. Managerial careers in dynamic networks tend to follow "natural" routes where the position is a direct result of the tasks and responsibility one has had beforehand (see also Kanter 1984, 1989).

The function of the manager in the dynamic network is to be a coordinator of a team. When decisions are made in close consultation with all those involved and all available experts on the topic, it is important for managers to be able to delegate, to cooperate with their colleagues and to inspire them. These are the very qualities that women feel are particularly important in a managerial position, and this is where they think that they as women, have something to offer as managers.

These findings correspond to the studies on organizations and innovations where both Burns & Stalker (1961) and Kanter (1984) find similar differences between the stable and the changing and innovative organizations and situate us within the contingency school of organization theory (Burns & Stalker 1961, Lawrence & Lorsch 1967, Pfeffer & Salancik 1978). However, gender has not previously been drawn into analysis of the structure of organizations and their environment. We find that the gendering of organizations is influenced by the characteristics of their environment and by the structures that they develop to suit this context.

Static Hierarchies.

The other group of companies we have labelled static as opposed to the dynamic organizations. This is because they operate in very stable markets with few if any requirements to change. The centralized pyramid structure of the static hierarchy ensures a continual reproduction of the culture, which makes such organizations very stable. The organization will try to maintain the status quo in order to avoid disturbances. Therefore it is not open to change or ready to accept anything new or different. A frustrated man said:

"The responsibility for change lies with the managers, and they do not always welcome initiatives from below. We send proposals for new methods or new products the formal right way, but no get response. We, who receive the signals, are not allowed to follow them up, and the ones who are responsible for the follow-up, are not in the position to understand the signals."

In organizations dominated by men, women represent something new and different and will therefore tend to be met with rejection or scepticism. Women are, or are assumed to be, different from men and therefore they have problems being considered relevant and central to the organization. Women are allowed to do traditional women's work in women's jobs, such as office or secretarial work where they are subordinated to men in a "natural" way in these organizations. If, on the other hand, women impinge on areas dominated by men, such as technical work and managerial positions, they challenge the existing gender arrangement and hence the stability of the organization. A newly appointed female manager of a department told us:

"I did not get this position without a struggle. There were some old men in the department, and they had their crownprinces. Because I knew that, I contacted the union representative when the job was announced. I applied, and I went to the National Board of Equal Opportunity when I was surpassed. The old men were very angry when they had to give me the job after all."

In the static hierarchies we find all the well-known mechanisms described by Kanter and others (Kanter 1977). Women become invisible as professionals and get stuck in blind alleys. A young women in a static hierarchy told us:

"I never get any feed-back on my performance. When I prepare a paper, my boss never tells me that it is OK, or suggests any changes. The only thing he ever said when I asked him once, was that my handwriting was very nice. I manage in this job because I can bring work home with me and discuss it with my husband."

A career in a hierarchy involves promotion to a higher position. To get new challenges, new tasks and increased responsibility in a hierarchical organization, you apply for another job, either in a different department or upwards in your own department. A woman's chances of getting a better job are poor because they depend on whether she has been visible as a capable and important member of the organization. In order to become visible she must have had challenges, met them successfully and shown her superiors that she was professionally outstanding. In hierarchical organizations a woman is professionally invisible and this puts her in the back of the row for more important jobs.

Other research has shown that managers choose managers who are similar to themselves, i.e. with the same educational background, the same social background and the same sex and race (Mills 1963, Kanter 1977). Managers recruit new managers who will fill their posts in the way that they themselves want them to be filled so that the system will continue to function well. Anyone who is similar to the manager is assumed to think the same way as he does and to make similar decisions. Women are different from men and in some ways behave differently. Men who are similar to their managers and follow the same norms and values can make themselves noticed as supporters of the managers and be visible. This gives them the best chance of promotion. This homosocial reproduction at managerial level reinforces the reproduction of status quo and thereby male domination.

We had chosen firms with and without programs for affirmative action for women. One might expect that the firms with affirmative action would be the ones with good opportunities for women. This was not the case, however. The dynamic networks did not have affirmative action programmes. Some of the static hierarchies did. The affirmative action we found was typically not directed at the organization structure but at the motivation of individual women. This strengthens our point about the importance of focusing on organizational structure and not on the traits or motivation of individual women if you want to understand women's careers.

Women's opportunities in changing organizations.

According to our findings de-hierarchization becomes an important measure to increase women's opportunities. Recent studies of organizational change and structure of organizations (Piore & Sabel 1984, Handy 1984, Kern & Schumann 1984, Kanter 1989, Clegg 1990) focus upon a trend towards such de-hierarchization or de-differentiation as we have found in the dynamic networks.

Rosabeth Moss Kanter's more recent work on big corporations in North-America and Europe (Kanter 1989) suggests that these companies are moving away from diversification towards maximizing their core business competence. They develop by delayering the hierarchy and making the company leaner. The borders between the company and its surroundings also change through strategic alliances with other firms, subcontractors and spin-offs from the old mother-firm. They try to

strengthen their relations to the customers and to their business partners through alliances. Kanter call these firms post-bureaucratic or post-entrepreneurial because they try to combine the strength and stability of a big corporation with the agility and innovative capacity of the entrepreneur. The reasons for these changes are the changes in market conditions and increased competition.

Stewart R. Clegg (1990) uses studies of new organizational forms especially in Asian industrialized countries, but also in French, Italian and Swedish industry, to advocate the decline of modernist organizational principles based on a differentiation of tasks, familiar in Tayloristic and bureaucratic organizations. Clegg sees many examples of organizations that are highly competitive but are not conforming to these principles. He sees tendencies to de-differentiation and de-hierarchization which he labels as the emerging postmodern organizations (Clegg 1990).

If these tendencies are dominant, we could expect that women's opportunities are changing for the better. However, when we find that the dynamic organizations give women good opportunities for career and development, and equal opportunities with their male colleagues, that doesn't mean that they are de-gendered or gender-neutral. Dynamic networks will make use of women to further their ends, and they will use the women to the point of exploitation if they are allowed. They are based on the male principle of work orientation: "The job should be the foremost in your life, and the family should accomodate to job demands." They may be flexible and you may do the job wherever or whenever you want, as long as it is ready on time.

The female graduate engineers use this flexibility to juggle their job and family responsibilities in cooperation with their spouses. Only as long as women are willing to conform to this traditional male work-ethic are they given opportunities.

It is also a fact that gender -and sex- still plays a role for the women in the organization, even if they may have career opportunities or management positions. They may encounter sexual harassment in meeting with customers or other managers. Male colleagues at the same level, or at lower level, are still likely to have problems with women in authority. A female manager in a dynamic organization reported on how she felt she had to downplay her managerial authority towards a colleague who had been her competitor for her position. She felt responsible for his dignity and felt that she had to treat him as an equal even though she was now his boss. Thus "equal opportunity" organizations will still be gendered (Acker 1990). This brings us over to an explicit discussion on how to understand gender.

Gender and organization - reconceptualization.

Traditionally gender has been treated more or less as a dichotomous variable: as difference between the category men and the category women. This concept of gender as "difference" and a dichotomous variable has been challenged by feminist researchers. Black feminists and feminists from the third world challenged the concept of a woman's perspective that was supposed to include the interests of all

women (Spellman 1988, Aphteker 1989, Collins 1990). Changes in women's lives also made it problematic to use a general concept of woman. Women became diversified through their entrance into the world of work at different places, times and social levels. This has made a differentiation in the understanding of women necessary. Male and female and masculinities and femininities were introduced instead of the clear dichotomous concepts man and woman. The focus moved from the differences between men and women to the meaning of gender in different situations and contexts. Gender becomes a perspective from which society is understood as gender-constructed. This opens for analysing the gendering of seemingly gender-neutral phenomena.

In the course of the 80's the concept of gender or the gender system was developed (Harding 1986, Hirdman 1988). The gender system is used to refer to structural, relational and symbolic differentiation between men and women. Rather than asking how female oppression is produced and maintained as in the theories on patriarchy (Hartmann 1979), the question is how gender is an integrated part of processes and structures which have hitherto been considered gender neutral.

Theories on gender system make it possible to visualize male dominance and female suppression as being made up of a great many and different components and processes. Hirdman (1988) characterizes the gender system by two logics: dichotomy, dividing society into male and female areas, and hierarchy, with the male as the normal and universally valid form and the female as deviant, ranked below and subordinated. She understands the segregation of male and female as

something that is happening continuously through processes that create meaning and dominance. Human beings become men and women through cultural transmission, integration into social institutions and socialization.

Acker (1990) proposes a similar gender perspective for studies of organizations. She understands organizations as basically characterized by gender and the gender arrangement, i.e. the male domination, of the society. Gendering is not an addition to other structures or processes that are gender neutral. It is a part of these processes and they cannot be understood without analyzing gender.

Gendering in organizations occurs in at least five interacting processes (Acker 1990). These processes are:

- 1) Construction of divisions along lines of gender: division of labour, allowed behaviours, power and the means of maintaining the divisions in the structures of the labour market, the family and the state.
- 2) Construction of symbols that explain, express, reinforce or oppose those divisions. These can take many forms: in language, ideology or dress.
- 3) Patterns of interaction between men and women, women and women, men and men, including all those patterns that enact dominance and submission.
- 4) Gendered components of individual identity, which may include consciousness of the existence of the other three aspects of gender.
- 5) Gender is implicated in the fundamental ongoing processes of creating and conceptualizing social structures. Gender is a constitutive element in organizational logic as well as in the construction of class.

This gender perspective opens up for the possibility that differences between men and women may not necessarily be hierarchic, that is dominated by men.

According to us, this perspective makes it possible to see ruptures in the general oppression or subordination of women. It indicates a possibility that even within a general male dominated society, we may find situations without female subordination, i.e. gender differences without hierarchy. Within this perspective we can understand our findings of some organizations offering women the same opportunities for careers as men.

In the following we will show how gender in organizations can be understood as an integrated part of political and cultural processes in organizations. This indicates a move from a predominantly structural perspective to a perspective where we combine the structural with political and cultural traditions.

Organizations as gender-political systems.

Thus far in the analysis of the empirical findings of this paper, we have had to differentiate between organizations to understand the conditions under which women are given good opportunities. If we had stopped with this structural perspective, we would have treated organizational structures as gender neutral and gender as a dichotomous variable. We will now analyze the organizations as political systems, as the arena for power, conflicts and interests (Morgan 1987), and we take this one step further by introducing the term gender-political system.

Burns (1961) shows that modern organizations promote forms of political behaviour because they are systems simultaneously involving cooperation and competition. These conflicting dimensions are clearly symbolized in the hierarchical map of organizations which is both a system for cooperation, a rational sharing of the tasks, and a career ladder to motivate individuals to upward mobility. As there are fewer positions the higher one gets in the hierarchy there is progressively more competition. In our study we found that one of the great differences between the two types of organizations was the multiple challenges in the dynamic networks compared to the very limited career openings in the static hierarchies.

In the hierarchical organizations women have to compete with men for limited organizational rewards such as promotion and opportunities to influence decisions (Harlan and Weiss 1980). This competition makes the conflicting interests, the unequal power and the possible conflicts between men and women within the organization visible. In a gender perspective it becomes clear that the conflicts, power and interests within an organization also include what men and women are allowed to do, how they are allowed to behave and how men and women are to be ranked and valued. This is one of the main gendering processes in the construction of the gender political system in organizations. We found that especially within the static hierarchies the competition between men and women for opportunities was a problem for the female graduate engineers. Their male competitors made gender an issue to exclude women. In an occupation that has traditionally been totally male dominant and in an organizational structure where women are made invisible as professionals this was not very difficult.

We have in our analysis of the two types of organizations put much emphasize on a structural explanation pointing to the differences in structures between hierarchies and networks in our analysis of the two types of organizations as gender political systems. By labelling them static hierarchies and dynamic networks, however, we have also pointed to the close connection between the organization's culture and its structure. The general climate in dynamic networks is positive towards women because of the openness towards new ideas and approaches, while in the static hierarchies women are seen as "foreigners" or intruders because they are different and may threaten the status quo. Gender is an integral element in both the structure and the culture of the organizations, and we will therefore advocate an approach that does not separate structure and culture, but see them as two interlinked aspects.

In our analysis of the two different types of organizations we found that they were gendered in very different ways; they produce different gendering processes. By introducing gendering processes in organizations, we also introduce the actors within the organizational structures. We can understand static hierarchies and dynamic networks as organizations with different gendering processes. The two types of organizations with their different organization structures become arenas for different types of organizational actors, or stages where different types of organizational actors can play the leading part. The two types of organizational structures make room for different types of men and women, different masculinities and different femininities, "placing" some men and some women in the foreground and others in the background.

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We will develop our analysis of the two different types of organization further by using more of the data from the case-studies and some of the data from the surveys. We will especially present data on the differences between the women and the differences between the men to understand which types of men and women, or masculinities and feminities, will have opportunities in the two types of organizations.

According to this way of analyzing the organizations, the static hierarchy can be seen as a stable patriarchal organization in the traditional sense of the word, where the older men rule over the younger ones. The rules of the game are old and well-known, and the younger men are disciplined by the competition for careers and possibilities that the elder can bestow upon them. Women are in principle non-persons in these organizations. It is primarily a question of fathers and sons or kings and crownprinces, not of daughters or princesses.

Dynamic networks are organizations in change without the same stable power structure. This gives the younger (and dynamic) men - and in our case also crucially the young dynamic women in the organization - opportunities for development, career, influence and power. Dynamic networks suit the young professionals who want to expose themselves now and not in the far future. They don't want to be the subordinates of the older men, controlled by them.

In these days, it is "in" to make room for women in the organizations at least in Scandinavia and in the US, and a totally male dominated organization is no longer

legitimate in Norway. "Modern" organizations therefore can be seen to promote women's opportunities, at least in words. Dynamic organizations are examples of modern and innovative organizations. They give room for women, at least for those women who participate according to the same principles as the young and dynamic men. Many of the female graduate engineers do: they want a career as well as a family, and they want to show what they can do.

The dynamic network may therefore well be the organization for the dynamic men and the "new" women whereas the static hierarchy is the organization for the old men and their subordinate and loyal crownprinces. Female graduate engineers as a group are typical representatives for the "new" women: women who choose professions and careers like men do and who do not accept a traditional female role in a subordinated position at work. We have seen that the female graduate engineers had better opportunities in dynamic networks than in static hierarchies. If we look more closely at the women in our study who have made a career and reached management positions at middle level, they are mainly from a category of women that we in our book have named "the challengers" (Kvande & Rasmussen 1990, chapter 11). They are women who have chosen both a career and a family and who create a managerial role in their own way, different from most of their male colleagues. They are female managers. The more detailed analysis in our book also suggests that the challengers are typically their father's daughters: they are daughters of graduate engineers, most of them managers. They have fathers who have motivated them and supported them in choosing an untraditional education and profession like engineering. Therefore they come equipped with both

the technical interest and also the class-background that give them confidence and strength when they go into the male dominated profession.

To refer to opportunities for female graduate engineers in the dynamic organizations is not necessarily to say anything about the opportunities for other women in the same type of organization. It may say something about the opportunities for the women who are "more like men" in their attitude to work, that is who want to participate in working life like men and who do not accept a subordinate position or show traditional female attitudes. The situation may well be different for other women and for women at lower levels of the organization.

If we combine a political and a cultural perspective, organizations can be understood as arenas where multiple cultures and countercultures compete to define the nature of situations. The corporate culture can then be understood as a result of political processes where different groups with different interests compete (Frost 1987, Meek 1988, Knights & Wilmott 1991, Knights & Morgan 1990). Gender identity, like different masculinities and femininities, is an important element in these processes.

Morgan & Knights (1990) use this perspective in their analysis of how jobs become gendered. Using a case from the banking and insurance sector, they describe how the aggressive male sales culture met with resistance from the male bank hierarchy. The bankers represented a masculinity that was very different from the masculinity of the sales representatives. The bankers were paternalistic, steady, responsible

and cautious whereas the sales reps were aggressive, high-performing, had to have "nerve" and "a bit of cheek" to persuade the public to buy their product. The bankers allied with the female staff at the counter to get rid of the sales reps from the insurance company in the bank so that the female clerks could take over the selling of life insurances. Morgan & Knights show how these discussions about the gender of jobs took place as a discussion about the bank's strategy (Morgan & Knights 1990).

We will suggest that when the female graduate engineers have good opportunities in dynamic organizations, it is because they match the dominant male group (the young "dynamic" men) in the company in their views on work and organization and in their opposition to the traditional male hierarchical rule. They "find" each other in their interests in getting something done in different ways, by alternative means. In Morgan & Knights' case we also see alliances between a dominant male group and a group of women against another and threatening male group leading to new opportunities for women. It may seem that the alliances between groups of men and groups of women is crucial if you want to understand the opportunities for women at work, and in these alliances the gendered work identities play an important role.

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Conclusion.

We started out by underlining the necessity for organization studies to confront the gender issue and for feminist research to acquire a better understanding of organizations. We also advocated a more differentiated approach to the issue of gender and organization where both women and men as well as organizations were seen as heterogeneous. In the first part of this article we have illustrated the importance of a differentiated view of organizations by choosing a research design which secured variation in organizational structures.

The focus on variations in organizational structure was selected as an alternative approach both to the dominant Women in Management literature where the focus has mainly been on women's individual traits, as well as an alternative to Rosabeth Moss Kanter's structural approach which included only one type of organization (Kanter 1977). This perspective turned out to be of great importance when studying female graduate engineers and their opportunities for development and careers. We found that the opportunities for career and development for women vary according to organizational structure of the firm. In the static organizations with hierarchical structure the women have poor opportunities whereas in the dynamic organizations with team-work and network structure they have good opportunities. These findings were discussed in light of new organization studies showing a development of de-hierarchization towards leaner and more flexible organizations (Kanter 1989, Clegg 1990).

As a second stage we have combined our empirical results with two strands of theorizing. We used elements from feminist theory on the understanding of gender and combined this with political systems theory and a cultural understanding of organizations. This enabled us to illustrate how to avoid analyzing organizational structures as gender-neutral like Kanter (1977) does, showing how gender is an integrated part of political and cultural processes in organizations. The differentiation in the category women and the category men enabled us to analyze the organizations as the arena for different gendered identities, different masculinities and different femininities.

We analyze the static organization as patriarchal: the old men's organization for control over the younger men, an organization where women have no natural place in the hierarchy of men. Dynamic organizations can be seen as the younger and coming men's organization: a place where they can "make it" without being held down by the hierarchy of the older men. It is also an organization, we can note, where they can form alliances with the "new" women, the ones that are "like themselves" in work-orientation and motivation. They can form such alliances against, or free of, the old patriarchal and paternalistic regime in the static hierarchy.

We have thus, through a differentiation first in organizations and after that in the categories women and men and masculinity and femininity, developed a more differentiated understanding of gender in organizations.

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SUMMARY OF ACTIVITIES

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EAST-WEST FORUM

Chair

Dora Dolle-Willemsen The Netherlands

Members

Valentina Zlenko	Ukraine
Hanna Ziajka	Poland
Vitalina Koval	Russia
Adela Rogojinaru	Romania
Seçkin Ergin	Turkey
Olga Plávková	Czech and Slovak Federal Republic
Mihaela Singer	Romania
Tatiana Koke	Latvia
Petya Kabakchieva	Bulgaria

After a short introduction Dora Dolle raised some issues to be compared between East and West: about equal treatment, relations between men and women, sex-differences and their origins, role expectations: choices men and women make, subject choices and the hidden curriculum.

Question to the forum members: What, in your system, works for women and what not?

Every participant was asked to introduce herself and discuss her topic:

Valentina Zlenko talked about **women's participation in the decision making process**. The low status of women in society could explain their underrepresentaion in the decision making process. Women's low status is worse than before. In the Ukraine less than 3% of the deputies in parliament are women, but there is hope for the future: there is an increase in political activity of young women in the student movement.

Hanna Ziajka's topic was **the situation of women in the cities and the countryside**. Theoretically there are equal opportunities but in practice most women work long days and have no free time. In younger families the sex-roles seem to be less restricted. Rural women have less opportunities than women in cities, because of cultural norms which means low status for women, very long work hours -on average 15 hrs/day- and scarce services (educational, medical) and shops. The catholic church is influential, also in the rapid social, political and economical changes in Poland today.

Vitalina Koval discussed **gains and losses after the transition**. Before the perestrojka there was official equality of men and women, but women could not critically discuss their situation. Now there are only 5% women amongst members of parliament, instead of 33% before perestrojka, but they are free to really express the interests of women. The economical situation is extremely difficult: 80% of families lives below the poverty line. Prices increased 1000 times, but salaries only 4-5 times.

Adela Rogojinaru told about **women in science and technology: male and female careers**. In the old regime there was "centralized feminism", with the wife of former president Ceaucescu as the "symbol of feminism". There are a lot of female engineers in Romania because of examination opportunities, but many would prefer more theoretical mathematics and physics studies. Getting in higher positions depends on professional competence, especially in new technologies (computers). It might be a dangerous development there are no women in new commercial activities, except fashion and light industry.

Seçkin Ergin's topic was **the position of women before and after the republic in Turkey**. Before the first world war Turkish society was patriarchal, the women were confined to the home, they had no constitutional equality, social security and they were discriminated in the family. After the revolution women got the vote (in the 30's), and they rose to higher positions but later on they were set aside. So the question now is: Do we make good use of our rights?

Olga Plávková discussed **the situation of women in the labour market**. After the revolution in 1989 there were changes in women's employment. Women are interested in higher positions, not only for economic reasons, but also because they want to use their education. But the majority of women is passively waiting for developments to take place while men take over the jobs and restrict women to the household.

Mihaela Singer talked about **changes in the curriculum in the face of economical and political changes**. The transformation to democracy and a market economy means that education has to be changed, in its presentational methods and in its contents. New subjects include technology and marketing. Teachers have to be trained for these subjects and gender-issues need to be integrated.

Tatiana Koke discussed **women's careers in science**. In the Latvian economy 55% of the women are employed and 58% of the teachers are women. Amongst scientific researchers 47% is female. A large proportion (52%) of students is female, also in the natural sciences, but there is a high drop-out rate amongst women, not amongst men. There are very few women in the highest academic positions. It seems women can now afford themselves the "luxury" of not having to work and be a housewife and mother instead.

Petya Kabakchieva talked about **the influence of the traditional model of equality upon the status of women in science and technology**. Bulgaria is an agrarian society in which the women do a lot of the work inside and outside the home. In 1990 there were 30-50% women in science. The father is the dominant figure in the family and women have lower status than men. The gender problem is not only related to economic issues, it is also a question of power. But in the socialist culture there was no vision of women's cultural emancipation.

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Discussion

Influence of parents

In Western society the most important influence on young women's choices appear to be the parents. This is/was not so in socialist or communist societies because of the de-emphasizing of the family and the emphasis on the 'brotherhood of men' and the production group. Children are brought up in childcare facilities, not in the family. The peer group has much influence.

Role of the father

The role of the father is rapidly changing and can become problematic when women demand the men take their share in household and childcare duties. The role of the father used to be very patriarchal, depending also on age, urban situation, religion etc. The father can be important as the counsellor to the daughter in a technological career.

New women's organisations

In many Eastern European countries new women's organisations develop. Or old women's organisations change towards new orientations. But it is sometimes difficult to find new ways of organisation and co-operation when democracy is still new.

Annita Alting

HOMEGROUPS

In the tradition of other GASAT conferences we formed homegroups. Homegroups are small groups which meet daily during the conference and are meant to reflect upon, discuss and synthesize understandings gained during the conference. They are pre-arranged groups, each with a non-native speaker as facilitator. The composition of the homegroups was as mixed as possible.

Homegroup meetings took place during the tea.

A short training session for homegroup facilitators was organized on Sunday afternoon.

We received the following report from Hannie Rodenburg-Smit who led the training session:

Of the nine facilitators seven were in the training session.

Warming-up

We started with an introduction and warming up by telling what our first ideas this morning were.

Earlier experiences with groups

To realize what it means to be a facilitator, we discussed earlier experiences with groups. Therefore participants answered at the following questions:

Which experiences do you have in facilitating groups? And of what kind of groups have you been a leader?

(Think of small groups varying from scouting groups to students at university level or in your worksituation.)

Next participants gave examples of a good and of a bad facilitating experience. They talked it over with each other. Some of them already had earlier experiences in GASAT-homegroups.

Expected problems in facilitating

All participants were asked to imagine bad and unpleasant situations in their homegroups next week.

They were asked to describe on a piece of paper what would be the worst and most unpleasant situation (emotional, social, intellectual or cultural

problem situations).

It gave a spectrum of problems, like: "Someone who never stops talking", "One of the people doesn't agree with the program and want to change the music evening for a discussion. She found 45 people who agree with her".

Suggestions for "solutions" of the problems or improvement of the situation

All participants wrote down ideas, experiences or suggestions which could help to solve the problem of their colleague. Examples to the problem of the person who never stops talking: " give all members 2-5 minutes time to speak", "make it a common problem, the talkative one should be prepared to be corrected by a sign, a joke or otherwise".

We read all the problems and the possible solutions/suggestions and each participant replied which of the suggestions of her colleagues fitted her.

Short evaluation

At the end of the session the participants were asked to give a short impression of the session. One of them would have liked more structure. But the main idea to introduce the task of the facilitator, appeared to be conveyed in a good and pleasant way: you learned to know the other facilitators and learned from them; you began to realize what the task looks like and became more familiar with it.

At the final homegroup meeting on Thursday, participants completed a conference evaluation activity and presented it during the last plenary session.

The following evaluation questions had to be completed:

I liked ...

I thought ...

I learned ...

I would have liked ...

Summary of the evaluation in the homegroups

I liked

Atmosphere

(often mentioned as: pleasant, co-operative, friendly, cohesive, positive, informal and caring)

Meeting people

(mentioned were: Eastern Europe, old friends, new friends, own country, diverse nationalities)

Design of the conference

(variety of format, discussions in a variety of small groups, active/passive, papers/workshops)

Sharing ideas/strategies

(variety of experiences, ideas and opinions, comparing experience with others, similar thinking)

I thought

Some of the workshops were too divers; the conference to be more theoretical/to be more practical; paperpresentations were well; the GASAT conference is a real stimulation for the motivation you need to do your job.

I learned

Differences between countries in (Eastern) Europe; different countries/ different cultures; complexity of gender and science issues; political, economic and gender situation in Eastern Europe and Turkey; researchers in Eastern Europe have many problems/gender is low; about other peoples experiences and training courses.

I would have liked

More time

(for: homegroups, meeting Eastern European women, to reflect, to ask questions, free time!)

Papers earlier

More travel information; less luxureous hotel; other organization of dinner (faster, vegatarians not separated)

Swimming pool fixed.

Papersession I.1
**SCIENCE AND TECHNOLOGY EDUCATION IN EAST AND WEST
EUROPE**

Marja Brand

Ten years Ment-project girls into physics and technology education

Alan Durndell

Gender, science, technology and engineering: education in Britain and Bulgaria

Hana Nováková

The philosophy of technology education in our democratic school

Carrie Paechter

Gendered subjects coming together: power and gender in the design and technology curriculum for England and Wales

No report received.

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CHANGING TEACHER BEHAVIOURS AND COLLABORATION IN CLASSROOMS

T.E. Dolle-Willemsen, J.C. Rodenburg-Smit, L.C. Engelfriet, M.J.M. Verbruggen
Changing teachers' attitudes to gender issues in education. Systematical classroom observation an instrument!

Magda Man in 't Veld

A teacher training course on gender inclusive strategies for teaching science & technology

Helene Sørensen

Is it possible to change science-teachers' way of teaching?

Elizabeth Whitelegg, Patricia Murphy, Eileen Scanlon, Barbara Hodgson

Investigating collaboration in primary science classrooms: a gender perspective

Dora Dolle explains that their paper deals with the results of an action research project on classroom interaction and teacher training. They organize courses for graduate students, postgraduate students and teachers on classroom management by using self-evaluation, computer technology and role play and focussing on values of question techniques. Videotaped lessons are observed and evaluated. One of their findings is that it is very important to start at the level of the participants.

Magda Man in't Veld says that her paper is a report of the implementation of a new course in the training program for technology teachers. The participants of the course are adults, some of them experienced teachers. The Australian GAMAST project served as a model. Objectives of the course are gender inclusive teaching strategies. Including women and girls in the curriculum of technology education means including male as well as female values and qualities. This implies a new image of technology: inventing, using and evaluating technology. Furthermore this implies teaching strategies which involve all students in the learning process, and non-competitive assessment.

Helene Sørensen has been working with science teachers in the Danish primary school system, who did a lot of practical work. She found the teachers were in control of the class and the learning process. Her further aim was that pupils get ownership of their own learning process. She was a

participant observer and worked as a consultant of teachers. She used meta-cognitive strategies but it turned out to be difficult to change the teachers' behaviours. You come too close to the individual teacher's personality.

Liz Whitelegg says her group looks in the first place at working in small groups in primary education, while Christine How is looking at its gender aspects. How can the tasks of small groups be formulated in order to stimulate co-operative learning. More structured tasks are needed to make it possible to guide the teachers' behaviours. Open ended questions have the effect that girls will find out what the teacher wants.

Hannie Rodenburg summarizes that changing teacher behaviours is difficult. She asked the participants of the paper presentation to formulate their questions in small groups of four persons. This turned out to be a good strategy to involve everyone in the following discussion.

STUDENTS, LECTURERS AND TEACHING METHODS IN MALE DOMINATED UNIVERSITY CONTEXTS

Seçkin Ergin

The use of bilateral relationships to promote curriculum development for girls' vocational schools in Turkish speaking Eastern European countries

Petya Kabakchieva

Women university lecturers in the eyes of their students. Hypotheses and socio-cultural prerequisites in Bulgarian experience

Anette Kolmos

Metacognitive aspects in a group-based project work at technical universities

Marjan van der Wel, Marjon Menten

Being a student at Delft University

Summary

The discussion considered interaction between male and female students and female lecturers within different educational structures and methods. It was concluded that there are problems but these cannot be solved through applying different methods to an unchanged system (e.g. project work). It is a broader problem related to attitudes of students and teachers.

Discussion

We identified a common problem: the communication between male and female students. It was suggested to use group processes to break down barriers through interactive project work.

We discussed the basic problem in Turkey: religion. Girls went to single sex schools which was better than no education, and it gave them a chance to go to university. These girls then become non-traditional Muslim girls. In Turkey and Bulgaria this method produces the social mould of the country and also the cultural basis of the country. But, the girls face difficulties in the labour market and a lack of power. In The Netherlands female students feel the same (as males) but they are treated differently. In Latvia interaction in education does not lead to interaction in the labour market. In Poland and Finland and the United Kingdom it seems like male and female students are treated the same but they don't go into science and technology.

Reasons for this:

Education reproduces traditional male and female roles. Technical Universities are suited to boys (masculine). Single-sex schools lead to poor social development of girls. Professional hierarchy is dominated by men. Male dominated courses are unattractive. Girls in these courses are noticed for their sexuality, not their ability. Girls have to prove themselves to be committed and better than average.

Angela Srivastava

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**ATTITUDES, BEHAVIOURS AND PREFERENCES OF SUBJECTS
AT SCHOOL**

Luigia Bosman

Fostering gender equity in science and technology education

Jackie Bradshaw, Sue Clegg, Deborah Trayhurn

An investigation into gender bias in educational software used in English primary schools

Joke van Heugten, Marijke van Vonderen

Choice of subjects at pre-university level

Leila Räsänen

The gender gap in learning physics concepts

After a short introduction of the four papers in the session the discussion began with examining the role of cultural contexts in influencing development of subjective norms. The work on computer images for software used by young children, indicated that gender neutral characters used with young children already signified gender and were interpreted as gendered by children. The role of cultural contexts and parents possible accentuation of norms was questioned, was the response found in UK likely to be repeated elsewhere? Speakers from Romania felt that a global cultural context was not possible, finding that education practisers reflected society rather than influencing development in society. This was developed as J. Eccles pointed out that cultural context affected decision making, attitudes and perceptions also. The software images paper indicated the need to deconstruct the images presented using examination of the signification process itself as art practitioners had shown that simple reversals of gendered images are not successful in subverting stereotypes. This meant that readings of the images are worded with children, teachers and parents very early. This would develop reflexivity of childrens thinking and make gender readings conscious. Further work was needed to examine the extent of choice and images used in East European countries.

Definitions of good models of pupils vary culturally as do pedagogic models applied in different countries. In some countries children and staff may have to be taught to use freedom (Latvia). The metacognition of learning and the

work of Vygotsky and Davidoff were questioned in terms of their models adequacy for dealing with gender. This, Räsänen, explained, treated the teaching/learning situation as identical for all pupils leading to Beyers suggestion that Angubel and Nowak focus on the role of the teacher and language use may be a profitable source for development of a common platform for inclusion of gender in social construction. Work in Romania, to develop a new maths and science curriculum for schools, will be based on cognitive processes developing links and levels of pupils abilities/skills and abstractions.

The need for early intervention with parents and their influence, to counter the gendering of subject matter prior to pupils meeting it, was stressed. As suggestions, out of schools activities, a possible network for science centers, early work in science starting from everyday experiences with curriculum changes for science particularly were stressed. A reminder that a theory of decision making was still needed closed the session.

Deborah Trayhurn

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Papersession I.5
ACCESS TO ENGINEERING EDUCATION

Erik Andreasen

A newly formed integrating education

Angela Srivastava

Gender and science and technology 1992

Joan Wolffensperger

Gender issues in masters programs

Hanna Ziajka, Eugenia Malewska

Vocational and technical education in Poland with particular stress on agricultural schools

The papers were presented and discussion followed. The group was divided into groups of three people. Each group discussed the papers and then fed back their questions and observations to the whole group in a plenary session.

There was some discussion about Hanna Ziajka and Eugenia Malewska's paper concerning first of all the question as to whether it was necessary to run programmes aimed at increasing the number of women in agriculture. Hanna argued that there was no need for any special strategies. It emerged from discussion that approximately 50% of university and 15% to 20% of technical university staff were women in Poland. Technical universities are more related to engineering and industry specific disciplines and universities are much older institutions dealing originally with humanities. Hanna Ziajka argued that the aims of males and females differed in relation to family considerations. There was some debate about the nature of work; in particular what constituted a hard job.

It was said that in The Netherlands in the past it were the daughters of farmers that entered agricultural education. Discussion developed on the subject of women in agricultural society and argued that the situation had changed somewhat in recent times. Data gathered in The Netherlands indicated that women were in much higher proportions in certain branches of agricultural science, exceeding the proportion of males. Examples included food science and environmental technology.

In Poland it was stated that recently competition had been introduced in the selection of students for agricultural courses. The female candidates did consistently better. It was suggested that they were more highly motivated. Research into how much time boys and girls spend on homework indicated that in The Netherlands males and females devoted equal time to their homework but that this was the lowest in the European countries studied.

There was discussion relating to Angela Srivastava's paper about access programmes and their part in reducing barriers to women in higher education. The need for equal opportunities policies, monitoring and research was discussed. The role and percentage of male staff in the context of masculine culture was raised but not developed.

A question was raised concerning the course referred to by Erik Andreasen for Export Engineers. He explained that the women on this course had to contend with the "nick name" of Escort Girls. This was seen as an undermining device used by men on traditional engineering courses. Academics also contributed to this by putting forward the argument that the course was a bit of everything with a superficial view of engineering. First destination statistics showed that the positions and salaries of graduates from this course were at least as high if not higher than those graduating from traditional engineering courses. There was general agreement that supportive fathers and background were important factors with respect to women entering engineering.

It was asked: Do we need to greatly change traditional engineering curriculum or do we create new courses to increase the proportion of women in engineering and technology based industries. Some argued strongly that it was teaching methods and subjects in the curriculum that needed to be changed and not the development of new courses. It was seen as necessary to train good teachers and focus on the use of feed-back from students. It was said that it was no good "to add more women and stir" as this would not challenge the dominant masculine culture. It was generally agreed that the demographic problem was currently obscured by the

recession in the West but that in the future this factor would lead to pressure for changes aimed at increasing the number of females studying science and maths in schools.

It is difficult to discuss the significant points of similarity and difference between so called Western and Eastern European countries. It seems that it is necessary to develop a framework for analysis if mutual benefits are to be derived from future GASAT workshops.

Andrew Gale

ENCOURAGING WOMEN TO PROFESSIONAL EDUCATION AND CAREER DEVELOPMENT

Jan Harding

Changing images: women's institutes and science

Anne Randmer, Viive Krips

Estonian businesswoman '92 - sketch of a portrait

Diana Thompson

*Positive action to encourage women returners to follow higher education courses in computing:
A case study*

A summary of the three papers was presented: from Estonia the training of women to run small businesses, from the UK, a project to prepare mature, unemployed women (over-25 category of Euro Social Fund [ESF]) in information science to Higher National Diploma level, and a science course for Women's Institute [WI] members. This latter course was designed to break down the alienation 'ordinary' women felt towards science, the course could be used for a qualification and a few women went on to enrol in further formal courses.

Discussion

* How do you get funding?

(Diana) It needs to come from outside the university. The ESF funding is for two years only and then a further application has to be made. ESF contributes 45% of cost, the university 55%. But if ESF funding is not given in the future, the course will not run. Women do not have to be registered unemployed to get on the course but they cannot have been employed, for tax purposes, during the previous year.

(Jan) Funding for the WI course came from the Committee On the Public Understanding of Science [COPUS]. It was a one-off, seeding course which is likely not to be repeated. The WI is now expected to encourage science activities in its regions. COPUS will fund a seminar for the science 'experts' in the regions (those who have responded positively to an enquiry as to their willingness to help WI groups) to share ways of working with mature

women, who 'reject' science. Some 'Hands-on' science/technology centres are being encouraged to make their centres more women-friendly and to explore the possibility of equipping a mobile unit which would be available to resource meetings in village halls, etc.

* WISE buses [WISE - Women Into Science and Engineering]

Information was given about the buses equipped with technology units: pneumatics, electronics, mechanics, which have become available in the UK since 1984 (WISE year). Several participants had visited or used a bus. The idea and use of such a bus was criticized as follows:

- the units were 'traditional', not related to real life and problem-solving,
- the equipment often did not work,
- every girl would have perhaps half an hour in the bus - What use is this?

* How can courses for women go beyond 'fun'?

Jan described how she used the unit 'Wash'n'Wear'. Small experiments were made with water; e.g.:

- Comparing the sizes of drips from an eye-drops tube. Pure water makes larger drops than water-with-detergent. Why?
- When powder is shaken on a dish of water (just to show up the surface) and a tiny amount of detergent touched into the centre, the powder shoots to the sides. Why?
- Why can't you blow bubbles with only water? Detergent and water make bubbles. How is water held together?

From thinking about these and other simple experiments we make guesses about the structure of water. This can lead to simple structure of the atoms of hydrogen and oxygen.

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VALUES AND EMPLOYMENT IN ENGINEERING IN EAST AND WEST EUROPE

Ruth Carter, Gill Kirkup

Why do we still have so few women engineers in Europe and the USA?

Ludmila Gurjeva

Social-economic position of women of Siberia during the crisis

Vitalina Koval

The impact of new technology on men and women

The following issues were suggested as arising from the three papers:

1. Comparability of the title 'engineer' and its social status East/West.
2. The role of the military in technology and as a driving force in industry. Visible in the East, pervasive but invisible in the West. The connection between militarism - technology - masculinity.
3. Values - female, feminist values/male values. Women's values are not necessarily feminist values.
4. Protective legislation for women in employment: is it helpful, what is its effect on the status of women/their wellbeing/their children?
5. Strategies for support for domestic work and childcare.
6. Demands on the system/state/structures/individual men.

The majority of the discussion dealt with protective employment legislation and its impact and legislation in the East for flexible working for women. Historical comparisons were made with 19th century legislation about women's work in West. The dreadfully hard, physically demanding, work with long hours that many Russian women must still carry out, was compared with the variety of choices, in theory, open to women in the West.

Common feminist values were felt to exist and to form a possible basis in the East and the West for redirecting technology towards 'humanist' objectives rather than militaristic ones.

Gill Kirkup

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RESTRICTIONS AND STRATEGIES IN CAREER DEVELOPMENT

Marja Brand

"Sjhhhhh Mommy is reading" or Work and family issues affect us all

Sonja Hall, Deborah Trayhurn

Views of women managers working in the U.K. petroleum industry

Valentina Zlenko

Women's status in the Ukraine: employment, training, education, career development

Sonja Hall raised three questions from her paper:

What can be done to tackle gender-powered work relations?

What must organizations have to help women enter senior positions?

Do ♀-only networks help women aiming at senior management?

The Ukraine has been an independent state since July 1991. The economy is in deep crisis - high inflation and unemployment. There are 20 political parties. The Republican parties do see a solution to unemployment by encouraging ♀ to return to their homes.

The most important for young people is not education but how to earn high salaries, teaching salaries are low (less than bus drivers). Some girls are even turning to prostitution (which is now permitted) to earn good salaries. Over ten million ♀ engage in some form of economic activity, but 80 % is unemployed. 61% of the ♀ have higher specialist education. But only 3% had undergone special inservice training because this doesn't often improve employment position and because of lack of time due to responsibilities at home.

♀ are continual to be victimized in economic and political spheres. It is not seen as appropriate for ♀ to be in these spheres. Now there are some new openings for ♀ in small businesses e.g. banking.

Recently an Ukrainian Centre of ♀'s Studies has been created but it has no funding. There is only one government department concerned with ♀'s issues, but this is in the Department of Sociology. A commission in the parliament has a bureau for women and children but this is led by a man! There are only 12 ♀ in parliament.

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♀-only networks

Discussion about the value of ♀-only networks is only useful if these networks are well organized.

Since 1990 women in Romania have been confronted with three things:

1. Attitudes against ♀.
2. Model of Romanian ♀ in parliament, some had poor reputations.
3. ♀ voted for the former president. Men considered that this was due to hormonal influences. The former president was often on TV and was good looking.

So now we can see the reaction against the promotion of ♀, because in the recent past the wrong ♀ were promoted. Women accept this, -interested in going back into traditional women's activities- prostitutes, models.

If ♀ get high positions, other women are suspicious of the relationship with her boss. Lots are to be gained by international co-operation between women's movements.

A question was asked about sidelining of ♀ within companies and how to avoid this. Opportunity 2000 (a UK initiative) was introduced and the virtues of monitoring which categories of jobs women filled and setting targets for the future. There is a tension between the economic recession and utilizing women's skills.

The difficulty of taking time out to have children particularly for women on short term contracts was discussed; the model of career development is a male one.

A new strategy has been tried with some success in UK by arguing that research projects will be in jeopardy if key ♀ researchers take time out to have children so projects are not completed on time.

Does levelling of management structures (either through introduction of new technology or devolution of budgets) make lives easier for ♀? If it means working with a small team so that if one person does not take all (her) heavy burden, close colleagues have to do extra. Devolution produces high accountability but lack of overall (financial) control.

Some survival manuals for careers in education, management and industry for ♀ have been produced.

Papersession II.9
WORK AND FAMILY: HAVING IT ALL

Gisela Notz

Women want both: job and family

Olga Plávková

Women's employment in creation of labour market in Czechoslovakia

Els Veenis, Anja van den Einden

The limitations to the support for working mothers and caring fathers

After introducing the authors each of them summarized the main points of their papers. Conclusion after the short paper presentation was that in spite of differences a clear picture appears: it is a struggle - and more so for mothers than for fathers - to combine work and family.

The first question raised in the discussion concerned the social class of research groups since - as was pointed out - child care problems may be solved with money, for example by employing a nanny. This solution had not been encountered in any of the studies.

Another question concerned the provision of child care facilities by the state. The picture seems to be that in Western Europe, excluding Scandinavia, women's participation in the labour market is relatively low, and so is the provision of child care facilities. In Eastern Europe before 1989 all women were working full time and sufficient child care facilities were provided. These facilities are now disappearing, thereby creating problems for women since they want to remain in the labour market on full time. It was mentioned that if women do have a job and do earn money they can set up private child care facilities themselves, they do not need to rely on the state for assistance.

It was stressed that it is important that women have a choice of whether to work full time, part time or be a housewife/mother. This choice, however, must be a real choice, by ensuring the existence of sufficient child care facilities, since it is very difficult to re-enter the labour market after having

opted for the housewife/mother solution for a period of time. It was pointed out that a part time job - a strategy often encountered in Scandinavia - does make the woman economically dependent upon her husband's income.

A statement was made that when the labour market needs women child care facilities will be provided but when the women are not needed any more, dominant ideology will be strongly in favour of motherhood. In a reaction to this statement it was said that motherhood is more than ideology - it also concerns quality of human life, and is deeply embodied in women, whereas fatherhood is a social structure.

In conclusion it was said that the situation has to change both in family life and in working life in order to reduce women's struggle for combining work and family.

Mona Dahms

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Papersession III.10
RESEARCH METHODOLOGY

Andrew Gale

Women into construction: reflections on findings and recommendations of two recent evaluation exercises on experimental insight courses for school students in Britain

Tamara Sivertseva

The role of the family in the life of muslim women in Russia

N.M. Sretenova

Some reflections on the feminist paradigm concerning gender and science

The three papers presented were very diverse.

Discussion began by considering whether there could be a 'language' of feminist research. However, awareness of cultural differences in concepts was thought to make a common feminist language difficult to attain. The danger that linking feminist research to qualitative (subjective) techniques rather than quantitative (objective) techniques, could reproduce the very stereotypes and disadvantages that it was trying to address was painted out. Discourse shouldn't be divorced from practical effects.

Eastern or oriental philosophy was not the answer, being male dominated in practice. Post modernism, and deconstructing conscious reality was suggested as a method, but was not generally accepted.

It was suggested that males could be involved in feminist research, as long as they were limited in number.

There was much discussion about dichotomies: male/female, quantitative/qualitative, local/universal, western/oriental: these dichotomies often needed to be overcome.

There was no general conclusion about a paradigm of research, other than that several contributors suggested using a variety of methods.

Alan Durndell

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Papersession III.11
EVALUATION OF INTERVENTION STRATEGIES

Karin Beyer

Project organized university studies in science: gender, metacognition and quality of learning

Ilja Mottier

Technology assessment and women's studies: where do they meet?

Suzanne Wilkinson

Giving girls a taste of technology

Karin described the project-based courses at Roskilde University and the effect of learning in this way on students, teachers and the curriculum. Gender perspectives overlay the project courses. There has been an increase in the numbers of students on project courses and also those involving physics and maths. Project courses focus particularly on students having responsibility for their own learning and this has been a very successful pedagogy, "Ownership breeds success".

Ilja outlined the nature of technology assessment [TA] and the research areas, that the TA-unit in which she works has examined. She sees commonalities between discussions about the integration of TA into the mainstream issues and the earlier discussions about the integration of women's studies into various areas of the curriculum.

Suzanne described the four day taster course in technology at Oxford Poly. The evaluation of the course showed a great lack of information from girls about technology and careers open to them. There was an increase of 40% in those who would be interested in a technological career after the taster course.

K. Beyer's paper

Roskilde University has a reputation for project work, so the students are self-selective, they perhaps are less conventional already.

However, its more difficult to teach the conceptual structure of science and technology through project work, so half of the time is devoted to courses which teach the content. But work on the project may then give students a deeper understanding of the content areas.

607

I. Mottier's paper

Is the best strategy integration of women's studies into all areas, or separate areas? A strategy that does both is preferable.

There is a great deal of interest in TA from engineers, as they see advantages to society, but its not considered important to consider gender as well. Although we have enough knowledge to integrate gender issues with TA etc. how do we get the power to do so with so many players in the game, particularly when bidding for funds for EEC projects. It is therefore important to ensure that men also work towards the goals that women aim at.

S. Wilkinson's paper

The three technical universities in The Netherlands have been running two day residential technology taster courses for the past eight years. The ages of girls who come to these courses are 15-18 yrs. It is very difficult to find good projects that give a general cross faculty view of technology. In the first few years the impression was that the number of girls was increasing, but now it seems to be decreasing.

About the four day taster course at the Oxford Poly: Often the cost of running these courses is hidden, e.g. staff time is not fully costed.

In Sweden, such courses have been run since 1976. They found that the courses tended to be too superficial - students need a lot of follow up. Costs were reduced by getting present students to host the 'taster' students and provide accommodation for them. Numbers of students did slowly increase around this time, but other factors may also have had an effect.

In 1982-1983 in conjunction with employers' unions, the 120 girls attending the course spent one month in industry. This initiative was very successful and increased intake of girls to 29% (30% in mechanical engineering). These were not the girls who had attended the course -the initiative created a positive atmosphere for the university which encouraged other girls. After a few years the funding ran out and the girls also needed wages for the one month industrial placements. The moment the initiative ceased, the numbers of girls dropped.

Papersession IV.12
**CHALLENGE AND PERSPECTIVES OF EUROPEAN
PROJECTS**

Geoff Chivers

Gender issues within the EC's COMETT programme and the influence of the WITEC

Tatyana Izhevskaya

Academic careers of women in Ukraine

Jan Raat

Gender and technology education in Europe

No report received.

000

Workshop 1
SCHOOLCAREER COUNSELING

Workshopleader: Anja van Vlerken NVBI

No report received.

610

Workshop 2 and Workshop 7
TALE OF O

Workshopleader: Helen Hootsmans

The tale of O is an audiovisual presentation based on the book 'Men and Women of the Corporation' of Dr. Rosabeth Moss Kanter. It deals with the problem of being different in a group. The problem of one or a few O's in a group of X's. Being different refers to race, sexe, age, religion, language, function, weight or length. Essential is that you are in a minority position. After viewing the audiovisual we discussed about feeling an O with the help of some questions.

When did you feel an O?

In politics with all males. In my family, they are not as educated as I am. As a (male) student with a different point of view. When I have to contact authorities and present myself as a feminist. As a young researcher.

When do you feel an X?

At special weekends with my close friends. At conferences like this. Aboard of a plane. With my sisters.

Can you be recognized as an X or O?

Depends entirely on the situation and how you feel about it.

Is being an O an advantage or disadvantage?

They tell you things they wouldn't tell you if you were an X. More contacts because everybody talks to someone special.

You get a chance to give your opinion. Sometimes you want to be in the spotlight and when you withdraw from it you regret it. Yet being in the spotlight can bring lots of pressure.

Is it ever possible to be exclusively O?

Aren't we all both X and O? Isn't O-ness just an attribute of difference and it changes depending on the context and the content? When the difference is significant then you feel like an O.

Who is making the decision whether you are an O?

It is important that you are aware of your own situation and the way you think about yourself.

011

Workshop 3
**PROJECTWORK IN HIGHER EDUCATION:
ENGINEERING AND SCIENCE**

Workshopleaders: Karin Beyer and Anette Kolmos

The aim of the workshop was to share with the participants some experiences of projectwork. The organizers are teachers and researchers at technical or science departments at Aalborg University (AK) and Roskilde University (KB). Both universities offer programmes/studies which are problem oriented and project-organized although they differ somewhat in the subject-area covered and in the applied procedures.

At the start of the workshop, Anette Kolmos gave an introduction to set the scene. The participants had to imagine themselves as first year students at Aalborg University. They were then divided into projectgroups and asked to discuss possible problems related to a given theme and topic, to decide on the methods or procedures to focus down the problem-area to a reasonable problem for the projectwork to follow. The groups were also asked what courses they would like or have set up to support their project-work.

The groups were given 20 minutes before they had to report their ideas, plans and wishes to the teachers at a plenary session. A general discussion of various aspects and difficulties of project organized teaching and learning followed. The workshop went on for about 1 1/4 hour and there was no time for the planned more systematic summing up of the principles, the aims and possible procedures of project-organized university studies. Still the participants seem to have had a good and interactive experience.

Karin Beyer

012

Workshop 5

INCREASING THE INTEREST OF WOMEN FOR EXACT AND TECHNICAL COURSES AND STUDIES

Workshopleaders: Ria Hermanussen and Joke van Heugten

Which intervention projects aiming at more women going into technical studies and careers, are best used? In the workshop this question was discussed using four theses about girls/women and science and technology.

The first two theses were about which factors (e.g. curriculum change, teaching methods, single sex classes, etc.) are best used for interventions and at which point in the life-school-cycle?

It was generally agreed that each intervention is a good one if it meets the following conditions:

- there are as many actors as possible involved: teachers, parents, peers, even employers
- the intervention is sustained: it does not take place at just one moment in time, but it is continued.

There was little support for single sex schools, because it may result in a better achievement for girls in science and technology, but girls get into trouble socially. Apart from that it would make boys in single sex classes rather sexist. Separate classes for girls and boys for a few subjects (e.g. physics and maths) is a good idea though. Someone remarked all-girl classes are good for teachers too, because they learn to pay attention to girls' responses, while in mixed classes they are often geared at boys' responses. About interventions at secondary school in the age group 14-18 years it was said: 'intervention is never too early, but also never too late.'

Further remarks were about the difficult age of adolescence for girls: if the age in which one has to choose subjects in secondary school is about 14/15 years (like in The Netherlands) girls drop out of science. Later on they cannot choose a technical study because of the too high thresholds that universities of technology build for their incoming students. For example in The Netherlands physics and mathematics B (i.e. science oriented maths)

are required for entrance at a university of technology.

The last these (the third one we missed because of lack of time) posed the question: can a technical study and a technical profession be attractive for girls too?

If the relation between humans and the technical side is made visible, if it is clear that technology is made by people and for people, than it will be more attractive for girls. For example in Sweden there are 27% girls at technical universities and they are most in studies that are important for women and society, such as environmental studies.

It is different in East European countries: in Romania there are no sex differences in learning styles or results, as many girls as boys study technology: women are as able in abstract studies. Maybe it is because there are strong economic incentives for women too to study technology or to work in a technical field.

Joke van Heugten

014

Workshop 6

DEVELOPMENTS IN THE ENGINEERING PROFESSION: ADVANTAGE OR DISADVANTAGE FOR FEMALE ENGINEERS?

Workshopleader: Hanneke de Bruin-Scheepens

The discussion in our group both started and closed with debate about the image of the engineering profession. Functions in engineering are heavily stereotyped as demanding and masculine, and we discussed extensively the 'ideology' around these professions.

Since some members of the group came from Eastern Europe, we spend quite some time listening to information about the position of female engineers in this part of the world.

Though the prepared statements were not really used as an outline to discussion, there was a lively conversation going on for more than one and a half hour. In short we present some topics and conclusions.

1. Image of the profession

As we mentioned before, the engineering profession in general is seen as very demanding: it is not regarded to be a 9 to 5 job. However, we should keep in mind there are other professions -that seem to attract more women- in which the time demands are as uncertain, like for instance medicine. Especially for women it turns out to be difficult to combine the tasks of an engineer with other responsibilities. Women that work in engineering professions are often in an isolated position. That is why it is very difficult for women to obtain the 'credits' needed to realize changes in the professional environment in order to ensure a better combination of activities. Being the only woman 'on the floor' could have both advantages and disadvantages, mostly the latter outnumber the first.

2. Lessons from Eastern Europe

Most Eastern European countries have a higher percentage of female engineers than is common in the West. In Russia for instance, 58% of all engineers is female, just like 51% of all physics students at university. A reasonable explanation for this is given by the fact that all Russian pupils must attain the same program at school during 11 years, this program

contains relatively much mathematics, physics and chemistry. During this period there are three exams on all courses for all pupils; it turns out that female pupils are even slightly more successful than boys.

The compulsory character of this program with a large beta-oriented part, apparently makes an exact and technical advanced education for females much more accessible. It is said that the age at which kids get interested in science and technology is different for boys and girls: boys start at the age of 12 or 13, while it takes till the age of 15 or 16 for girls.

According to the East European women, the entrance of girls into technical and scientific education and professions, affected the prestige and salary of these 'male professions' in a negative way.

Furthermore, the large percentage of female engineers does not ensure them a stable position in the labourmarket. In time of economic depression (as is the situation in all Eastern European countries), experienced female engineers get as often unemployed as less educated women (in Russia 80% of all unemployed is female).

The implementation of new technologies did not help female engineers to get a better position. Frequently women are excluded from training and retraining courses (partly because of their obligations at home). The result is that nowadays often male managers are appointed to decision-making positions, even to positions that were held by females before. When there is a need for newly developed technology in industrial corporations, even female engineers in management positions, hire young male specialists to help them. Somehow even women themselves are systematically underestimating the capacities of other women.

3. Some conclusions

- * Compulsary courses in physics and maths to all pupils up to the age of 16 seem advisable.
- * Technical innovations work out badly for female engineers in countries where they are already extra burdened by heavy family tasks. Innovation in itself is certainly no guarantee for better chances for female engineers.
- * In times of economic depression even well educated and experienced female engineers get as easily unemployed as other women.

Workshop 9
HOUSE OF THE FUTURE; A HOUSE TO LIVE IN?

Workshopleaders: Annemarie v.d. Vusse and Marjon Menten

After a description of the house of the future by Annemarie and Marjon and a lot of critical notes everyone started to think about their own ideal houses in four groups.

Assignment:

What kind of criteria do you have for an ideal home? Take into account the way people actually live in your country. Write down, discuss, make a picture etc.

The four groups wrote down their criteria:

I

Square rooms, safe, you don't have to clean it, warm, dry, nice to live in, big/a lot of space, garden, sound proof (inside/outside), it has to save energy and should have: washer/dryer, stove/oven, refrigerator, freezer, personal computer with games, radio, compact disc player + good music, all working with solar/wind energy.

II

Flexibility: different lifestyles, OK for young and old, variety.

No more technology than necessary and which is useful, no more control than necessary, enough room for both co-operation and privacy, no animals and no smoking.

III

Safe place, personal unique crazy things, place to be creative, library, efficient household equipment, on the ocean coast and Irish wolfhound space.

IV

Fresh air, privacy, silence, possibility for pets, making music/place for instruments without disturbing others, trees/environment/neighbours, cosy/cozy atmosphere, not outward orientated but inward orientated and what about the church of the future?

Workshop 10
**KEY ISSUES FOR INTERDISCIPLINARY
WOMEN'S STUDIES COURSES**

Workshopleader: Gill Kirkup

The workshop examined in some detail the Open University (UK) course Issues in Women's Studies. This is a multi-media distance education course with almost one fifth of the course dealing with issues of gender, science and technology.

We discussed the problem of introducing theoretical writers such as Fox Keller and Harding to interdisciplinary students on an introductory women's studies course, the importance of introducing students to these writers in a way and at a point in a course which makes them accessible. We discussed the importance of beginning with issues that concern women - e.g. domestic technology or ecology and working into the theoretical. We talked about how most of us had been working hard to introduce issues from the Third World, and non-white women, we must now work equally hard to introduce issues from Eastern Europe.

Gill Kirkup

018

Workshop 11
ITEM

Workshopleader: Els Loeff

The objectives of Integration of Technology Emancipation and Management [ITEM] are to increase the number of highly qualified women in technology management and intermediary professions and to improve their career prospects.

The three main activities are:

- (re)training projects
- courses
- research and advice

In the workshop we looked at how to introduce innovations along the lines of a quality system. That includes financial aspects, time management, organizational aspects, quality assurance and information management.

C19

Workshop 12
**EVERY DAY TECHNOLOGY AS A TOOL FOR CHANGING
ATTITUDES AND CREATING SELF-CONFIDENCE**

Workshopleaders: AnnMarie Israelsson and Lo Fisher Teknikens Hus

The workshop began with a brief presentation of how the Teknikens Hus is structured and operated to develop understanding of how technology works and some of the science involved. It starts from 'real' technology and moves towards principles, not the other, more traditional move from principle to application.

The local technologies of the region are used: timber, mining, steelmaking, papermaking, hydroelectric power and building. In papermaking, for example, the paper is produced in the industrial way, not as in handcrafted paper, but the information given is limited.

Everyday technology is also used: a kitchen, a bathroom and a garage have been constructed.

Fifteen staffmembers are employed, including 5 trained teachers. They work with teachers, children and local council workers and design and make new exhibits.

In teaching children, close collaboration is maintained with the schools. Many teachers (mostly women) have attended courses, 97 % of the women teachers are fearful of technology at first.

Local authorities sent their complete cleaning staff to a course. Many of them have low education and poor self-image; a number of them has Finnish as first language. Many come reluctantly as they are sent to the Teknikens Hus for development training. Their course uses the three rooms for hands-on activities. In the kitchen they fit together a plug, some flex with a switch, and a light bulb. They take to pieces a watertrap from under a basin in the bathroom and change the washer in a dripping tap. In the garage they change a windscreen wiper. Many exclaim how easy it is (their husbands make it seem so onerous!) and resolve to go home and fix that tap!

Discussion

* How was the Teknikens Hus set up and how was it funded?

Discussions began in 1980 and the Hus was opened in 1988. Funding was obtained from local industry to build the Hus (on the university campus at Luleå where AnnMarie headed up the Information Office at the time). An investment fund was set up to contribute to on-going costs. Local councils made commitments to contribute and, later, government grants (temporary) were obtained.

* What position is taken on advertising for sponsoring companies?

No advertising is accepted, but real products do carry their manufacturer's labels.

* What if a group contains a woman already familiar with the technology?

She is asked to help or encouraged to work with an other exhibit, using a workbook provided.

* Can anyone attend a course and what does it cost?

Some occasional courses are offered for the public and the cost is small so as not to discourage participation. Admission to the Teknikens Hus is free. The public can use the workbooks.

* How do you evaluate?

Each course is evaluated by informal discussion and written feedback.

Teachers report on their classes reactions. A research programme is being designed to evaluate the cleaning staff course.

Roundtable
GENDER AND SCIENCE AND TECHNOLOGY IN EUROPE
GESTE

Discussionleader: Monique Volman

Short introduction about GESTE

GESTE stands for GEnder and Science and TEchnology:

In Sweden the first initiative was taken, the aim was to stay in touch between the GASAT conferences.

At the next GASAT conference in Australia other interested people were found. At this moment 40 people are already interested in the network. For a long time nothing happened, but this year the initiative was renewed. We got financial funding from three Universities in The Netherlands to make a new start with the network. The financial support is meant for the following activities:

- * possibility for structural base
- * investigate who/how many persons are interested
- * database/newsletter.

Everyone introduced her/himself shortly and mentioned what she/he expect from a network like GESTE.

Some of the statements that were made:

- a network helps to get in contact with similar researchers,
- to be informed/to inform colleagues,
- link in to international research,
- interested in teaching the teachers,
- interested in an overview in the research field,
- please don't duplicate WITEC!,
- interested in strategies to get all the knowledges,
- overview activities/research,
- supplying an interactive database, not another newsletter,
- the network will be of help to all of us.

With which ideas we came up and where we discussed about:

It is clear that WITEC does not overlap with GESTE. GESTE will be more limited and will provide specific information about research in certain fields and will bring people in contact with other researchers and developments.

A newsletter really is a one-way communication. Everyone is really happy to get one, but there is no feedback at all. So a newsletter does not provide a network. Everyone agrees on the idea of an interactive database.

We discussed quite a time about the design and form of the database: should it be large or narrow, how is the accessibility, should it be polyglot, should it be a part of the GASAT association. A lot of questions and no ready-made answers!

For Western Europe an interactive database would be very useful. For Eastern Europe it is a little bit more difficult, because of the lack of technology. It is possible to send these countries a print-out of the database.

Main thing of the discussion is that most of us are interested in the GESTE network and do agree on the idea of an interactive database.

Oda Weyers

POSTERPRESENTATIONS

GESTE

Gender and Science and Technology in Europe

Technica 10

Primary science club for girls

Hilde Scholtens

University of Twente

WITEC/UETP

Claire Molyneux and Geoff Chivers

The COMETT programme for Women into Technology in the European
Community / University Enterprise Training Partnership

Governmental projectgroup Women and Technology

Ans Compaijen (Ministry of Education and Science)

Integration of Technology Emancipation and Management [ITEM]

Els Loeff

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APPENDICES

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