Being female: A handicap for researchers competing for NCCRs?

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Abstract (Deutsch)

Der Schweizerische Nationalfonds für wissenschaftliche Forschung hat 1999 und 2004 erstmals Nationale Forschungsschwerpunkte (NFS) ausgeschrieben. Die beiden Ausschreibungen betrafen alle Disziplinen und brachten 126 Skizzen (pre-proposals) ein, die 2134 Forscherinnen und Forscher versammelten. Es kann davon ausgegangen werden, dass diese Aktion jene ForscherInnen in der Schweiz mobilisiert hat, die sich selbst als besonders qualifiziert für Spitzenforschung in ihrem Gebiet betrachten. Mittels netzwerk- und regressionsanalytischer Methoden wird untersucht, inwiefern Frauen aufgrund ihrer Geschlechtszugehörigkeit in den beiden Auswahlprozessen geringere Erfolgschancen hatten als Männer. Die Resultate bescheinigen im Ganzen gesehen den Auswahlprozeduren des Nationalfonds Genderneutralität. Sie bestätigen aber auch die bereits bekannte geringere Präsenz von Frauen auf höheren akademischen Hierarchiestufen und ihre Konzentration in sozial- und geisteswissenschaftlichen Disziplinen, und zeigen, dass diese Konzentration ihrerseits die Erfolgschancen von Frauen im wissenschaftlichen Wettbewerb vermindert. Geschlechtsspezifisch ungleiche Erfolgschancen, die biografisch vor der Teilnahme am Rennen um NFS liegen, haben demnach eine nicht vernachlässigbare Rolle gespielt.

Abstract (English)

The Swiss National Science Foundation made a call for National Centers of Competence in Research (NCCR) for the first time in 1999 and 2004. Together, these announcements concerned all disciplines and led to 126 pre-proposals, which were put forward by 2,134 men and women researchers. It can be assumed that this operation mobilised Swiss researchers who regarded themselves as par-

ticularly well qualified to conduct high-level research in their field. The article uses network analysis and regression analysis methods to examine to what extent women had a lower success rate than men in the two selection rounds because of their sex. On the whole, the findings attest the gender neutrality of the National Science Foundation's selection procedures. However, they also confirm the well-known fact that women scientists are less represented in the higher echelons of academia and concentrated in the social sciences and humanities, as well as showing that this concentration reduces women's chances of success in scientific competition. The article shows that unequal gender-specific success rates prior to the NCCR funding contest play a fairly significant role.

1. Women as participants in the NCCR contests

This article reports on the gender-related part of the results of a larger study commissioned by Division IV of the Swiss National Science Foundation (SNSF) to look into the factors influencing success in the two scientific competitions for National Centres of Competence in Research (NCCR) organised in 1999 and 2004 (a third call has been issued in 2008; it is not included in the analysis presented here). The first "run" allows for a comparison between humanities or social sciences on the one hand and natural sciences on the other. Since the second was restricted to the social sciences and humanities, one gains a better understanding of the differences and similarities between these so-called soft disciplines, as well as observing to what extent the underlying logics of the two competitions were the same. In order to use the successful launch of a NCCR as a main criterion (i.e., dependent variable), our analysis focuses on the pre-proposals that were submitted, which also include the unsuccessful ones. It required a considerable amount of work to gather information from the pre-proposals, the full proposals, the SNSF's internal database and the Internet. The main emphasis was on network analysis of the collaborative structure in the Swiss scientific community. The results of the general study have been reported by Widmer, Levy, and Giudici (2005).[1]

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[1] This report has not been published formally but can be obtained from the authors. Please contact rene.levy@unil.ch.

NCCRs are composite yet coherent research programmes that may run for up to 12 years, have a "leading house" (main site with a general direction), and comprise a series of individual projects that are located in different universities and are coordinated by the leading house. Their subject matter, scientific orientation and staff make-up are determined bottom-up, i.e. by the scientists themselves. The standard selection procedure contains four stages. First, following a project call by the SNSF, pre-proposals are submitted by self-determined groups of researchers, evaluated and graded by an international expert panel, with “A” being an invitation to elaborate a full proposal, “B” meaning that a full proposal may be handed in but with clear improvements, and “C” signalling scepticism about a full proposal’s chances of being accepted. Second, full proposals are evaluated by subject-based panels of international experts who then recommend which programmes should be accepted for implementation. Third, Division IV of SNSF, which is in charge of oriented research, approves certain proposals. Fourth, the final decision about the implementation of proposed NCCRs is taken by the Federal Department of Home Affairs, i.e. by the political authority responsible for research policy in Switzerland. In the 1999 procedure, the 18 projects proposed by the SNSF were whittled down to 14 in that final stage; in the 2004 procedure, all 6 projects put forward by the SNFS were accepted.

The aim of this paper is to investigate the impact being male or female has on the success a scholar encountered during these two processes of national high-level scientific competition. In fact, the two NCCR competitions in question are of interest to “analysts” of the conditions for scientific success because they were addressed to virtually every scholar in every scientific discipline in Switzerland who considered him- or herself to have the necessary level of excellence to take part in a research project of a scale rarely seen in this country. With some obvious limitations, our data can be used to determine to what extent women had a lower chance of participating in a successful NCCR project solely due to their sex and regardless of other relevant criteria. As we know, the phenomenon of discrimination against women - both inside and outside scientific circles - is complex and it will of course be impossible to cover all the potential factors. Our data do however allow us to examine several hypotheses that we feel are relevant.

One such hypothesis is inspired by the American sociologist R. K. Merton. In his work on the sociology of sciences (1973), he proposed the *principle of cumulative advantages* in order to explain why scientists may start their careers with very similar publication records and identical diplomas but end up having extremely

heterogeneous experiences in terms of both publications and grants - and this has an impact on their scientific reputation. Merton explained the growing disparities in scientists' status throughout their careers by the fact that past scientific success has an impact on the probability of being successful again; it is a circular process in which past success is used by scientific institutions as a criterion to attribute further research grants. So, getting more grants leads to more publications that in turn provide a further base for new grants, etc. This thinking indicates that women may be at a disadvantage compared to men because many of them become pregnant and take on much of the burden of childcare at a crucial stage in their careers (when they are between 30 and 35 years of age). This age corresponds precisely to the career stage in which a scientist's initial publication and grant records become the determinants for future successful applications. Another mechanism - one that is a more direct expression of sexual discrimination within academia and would support Merton's cumulative advantage/disadvantage process – may also be that they are less often invited to take part in prestigious research and publications by their seniors and therefore suffer from this being another basis of scientific evaluation. It should be noted that these twin hypotheses are unlikely to be directly relevant to women's treatment in the NCCR selection process, but rather explain the different level of success they experienced in their scientific careers before they were in a position to participate in this type of project.

A second crucial dimension that influences scientific success from a Mertonian perspective is the structuring of scientific research by *disciplines*. There is competition between disciplines as to which will get the greatest amount of financial support from scientific institutions and the industry. Researchers from different disciplines may join forces to submit interdisciplinary projects in order to beat their competitors. Disciplines are often based on dominant paradigms that may be contradictory to or barely compatible with the paradigms of adjacent disciplines. As in other professions, scientific disciplines are strongly sex-typed, and men and women are unevenly distributed across them: women are over-represented in the social sciences and humanities and under-represented in the natural and technical sciences. As a result, interdisciplinary projects tend to bring together disciplines along the lines of gender typification due to the unintentional workings of paradigmatic compatibility. We may furthermore assume that *paradigmatic diversity* (rather than complementarity) is more important in the social sciences and humanities than in natural sciences. The competition between social sciences and humanities on the one hand and hard sciences on the other may thus be a factor that reinforces gender inequalities. This hypothesis could explain sex-related dif-

ferences in success between different disciplines (natural vs. social sciences or humanities). To be more precise, disciplinary orientation should explain part of the sex differential in success.

Thirdly, science is a field where individuals of unequal *social status* compete with one another. Institutional organisations and academic norms expect professors to play a leading role in research and to have attained their position on the basis of scientific competence. We can therefore expect differences of funding between professors and non-professors. As women become increasingly under-represented the further up the academic hierarchy one goes, we may hypothesise that the unequal sexual distribution of professorship is an additional factor in funding inequality between men and women. This is another variable related to gender, but it is not intrinsic to it and should therefore "explain away" part of the empirical sex differences in success.

Fourthly and finally, many sociologists believe that a great proportion of the gender inequalities in science are based on men and women's unequal *social capital* or scientifically relevant networking. One may therefore ask whether social capital rather than individual characteristics may explain the outcomes of the 1999 and 2004 competitions. Social capital is traditionally defined as resources stemming from the possession of a durable network of acquaintance or recognition (Bourdieu 1980; Coleman 1988). The concept focuses on the benefits accruing to individuals by virtue of participation in groups (Portes 1998). Research has underlined differences in social capital between women and men, which to some extent explain their career differential in managerial jobs. Might this have played a key role in the competition to get funding for an NCCR? This is therefore a third factor that is supposedly correlated with sex but that directly influences scientific success.

These are the four main hypotheses to be examined by the following analysis, even though the information we are able to consider in our analysis covers a far broader spectrum of factors. They also alert us to the fact that there is a long chain of factors and that the selection of an NCCR intervenes at a relatively late stage in this series.

2. Data

The 1999 contest for NCCR funding brought forward 82 pre-proposals from a wide variety of scientific disciplines, which reflected the scale of the call. They comprised 962 individual projects stemming from 379 administrative units located within 117 institutions. 1,495 individual researchers participated, only 176 of whom were women, i.e. 13%.

The 2004 contest, which was limited to the social sciences and humanities, solicited 44 pre-proposals with 554 individual projects from 255 administrative units located in 30 institutions; it mobilised 639 individuals, of whom 129 or 22% were women. In both cases therefore, women were a small minority, especially in 1999.

Information about researchers and projects was collected mainly from the pre-proposals, secondly from the SNSF database of researchers and other internal documents, and thirdly through a complementary Internet search. It was gathered in relational databases under ACCESS, which makes it possible to extract key information at various levels of aggregation (individuals, projects, proposals, institutions, etc.), to create variables and analyse them using SPSS.

3. Measures

Success in the NCCR competition as a dependent variable: In order to estimate how well individuals performed in the race for NCCRs, we use 4 dichotomous indicators of success that correspond to the four stages in the selection process. The first is the expert grading of the pre-proposals but simplified to distinguish between A grades and others; the second is whether the pre-proposal was followed by a full proposal[2], the third whether or not the full proposal was ranked as excellent by the experts appointed by the SNSF (and thus put forward by the SNSF for funding), and the fourth whether in the end the full proposal was funded

[2] Although this depended primarily on the main researchers' own decision, it was influenced to various degrees by how the pre-proposal was marked. Almost all pre-proposals with an A mark were followed by a full proposal, all those with a C mark were abandoned, while there was more variability in the B category. One may hypothesise that more self-confident researchers who got a B mark tended to persist and to hand in an improved full proposal, whereas less determined scholars instead interpreted a B as a polite signal to give up.

or not. In this article, we mainly limit ourselves to the final criterion, i.e. whether an individual participated in a pre-proposal that led to a funded full proposal, or,in other words to a NCCR that was implemented. Technically speaking, this is our dependent variable.

Four factors of potential influence as independent variables: In order to disentangle the mechanisms that potentially explain the differential of success between men and women in the race for NCCRs, we focus on several independent variables, particularly factors that might potentially intervene in an individual's scientific career, which we describe below. Firstly, we collected information about the *discipline* to which researchers belong, for a theoretical and also an empirical reason. The theoretical reason is Merton's second hypothesis that we presented in the introduction to this contribution. The empirical reason is that, in the 2004 NCCR race, the SNSF considered this dimension explicitly, as the competition was officially limited to the social sciences and the humanities. In the 1999 selection process, no typical social sciences and human science project had been funded.[3] As a result, some researchers made the most of various opportunities to protest, including in the newspapers, that the social sciences and the humanities had been *de facto* excluded from funding - despite having been explicitly invited to participate - because the competition between them and the natural sciences was flawed from the outset. Therefore, one should consider this variable in order to understand the effect of gender on a scientist's chances of success, since we know that women and men are unevenly distributed across disciplines and that one's discipline had an impact on one's chances of receiving funding. In order to identify the participating scholars' discipline, we have used the CVs included in the proposals sent to the SNSF as well as information in the SNSF database, as well as certain websites in some cases. The precise meaning of this information varies from person to person, referring sometimes to the discipline in which he or she gained his or her doctoral title, sometimes to the discipline in which the person mainly teaches, or even the discipline of the institute or department to which the person is affiliated. Whenever we had a choice, we gave a higher priority to the first source over the second, and to the second over the third. For the overall analysis, we grouped the disciplines according to the divisional grouping of the SNSF itself (Div. I: human

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[3] It should be mentioned that one of the NCCRs implemented concerns (largely mathematical) strategies of financial risk management and has sometimes been labelled as belonging to the social sciences. We do not wish to enter into the debate about whether this attribution is correct or not, suffice it to say that its topic and method cannot be considered representative of the substance of social sciences or humanities.

and social, Div. II: natural and technical, Div. III: biological and medical) for the 1999 competition, and into social vs. humanities vs. mixed for the 2004 competition.

Secondly, the impact of *records of excellence* (reputational capital), corresponding to Merton's first hypothesis, was addressed through the number of projects an individual had had funded by the SNSF prior to the NCCR contest. This measure is far from ideal, since it disregards publications and external (non-SNSF) funding and has a built-in correlation with age. Its validity is also weakened by the fact that immigrant scientists may have had considerable funding success abroad before working in Switzerland and having the possibility to get funds from the SNSF; however, it was the only reasonable way to capture this kind of information within the time and resource constraints of our study (in particular, it was not possible to ask direct questions to the concerned researchers). This problem notwithstanding, it may prove to be of particular interest to our study because it focuses on the reputation each individual is likely to have with the SNSF linked to her or his record of achievement as evaluated by this specific institution. To compute this measure, we used the project database of the SNSF, which is available on the Internet.

Thirdly, *academic status* (our third hypothesis) is indicated by the simple dichotomy of being a professor or not.

Fourthly, the impact of *social capital* or networking (our fourth hypothesis) will be assessed in two ways. First, we consider the *number of pre-proposals* in which an individual takes part (without ignoring the fact, however, that this information may also be regarded as an expression of individual strategic behaviour). Secondly, we analyse networks of individuals by their affiliation to identical pre-proposals in order to measure the *centrality of their network position*. We shall say more about this in a later section.

In order to complete our analysis, we add other information that seemed potentially interesting and was readily available, such as age, position in the proposed NCCR structure, status of home institution, and, of course, the person’s sex.

4. Results

First we shall review the results for the 1999 race, then the results for 2004. In each case, we first consider the correlation between the four indicators of success

and sex. As a second step, we focus on the correlations between indicators of social status (i.e. being a professor or not, age, etc.), reputational capital, position in the project structure, and the person's sex. As a final step, we include all indicators in a series of logistic regressions in order to see what mechanisms may account for sex differences affecting the likelihood of getting funding.[4] A third section will be dedicated to the position of women and men in the overall network of collaboration in both 1999 and 2004.

4.1 Women and men in the 1999 contest

We first consider the likelihood of success according to a person's sex. Table 1 shows the distribution of the four indicators of success, i.e. success at the four stages of the selection process between women and men.

Table 1 Indicators of success by sex (1999)

	Men	Women	Cramer's V
N =	*1164*	*176*	
% who got a grade « A » on pre-proposals	40	46	.04
% who participated in a full proposal	53	62	.06*
% whose full proposal was proposed for funding by SNSF	29	26	.03
% whose full proposal was eventually funded	24	15	.07**

Legend: Cramer's V is a coefficient measuring the strength of association between two pieces of statistical information. The asterisks indicate the probability of the measured strength to be due to random factors, one asterisk meaning a 5% probability (difference has only a 5% chance to be random, considered "significant"), two asterisks a 1% probability (difference considered "highly significant").

Table 1 shows that there is no significant difference between the sexes' likelihood of getting an "A", only a weak one for participating in a pre-proposal whose leaders went on to submit a full proposal, and none for participating in a full proposal judged sufficiently excellent by the SNSF to propose it for funding. However, the actual funding is more strongly (and very significantly) gendered in favour of

[4] A regression is a kind of statistical analysis permitting to disentangle the concurrent "effects" of a series of "independent variables" on a "dependent variable". The status of independent/dependent is, of course, not basically inherent to the information considered but given to them by the analyst, and "effects" produced by that kind of analysis can be interpreted in a causal sense only with caution, especially if the data do not concern subsequent moments in a process. Logistic regressions are specifically adapted to dichotomous dependent variables (in our case: being successful at a given stage or not).

men: about a quarter of men received funding (24%), i.e. associated with an accepted NCCR proposal, whereas only one out of seven women did. This difference is significant at the .01 threshold. An individual's sex seems to become important only once the preliminary phases of the selection process are over, an intriguing finding to which we shall return later.

Table 2 Indicators of social status by sex (1999)

		Men	Women	Cramer's V[5]
Academic status (%)	Professor	63	39	.17**
	not professor	37	61	
Age (%)	-35	9	17	.16**
	36 – 45	35	48	
	46 – 55	36	25	
	56 – 65	20	11	
	+65	1	0	
Discipline (%)	Social sciences and humanities (Div. I)	31	45	.13**
	Natural sciences and engineering (Div. II)	34	18	
	Biology and medical sciences (Div. III)	35	38	
Status of home institution (%)	University	65	76	.10*
	Fed. Inst. Technol. (ETH)	22	12	
	Autonomous institute	6	7	
	Private firm	4	4	
	University of applied science	2	1	
	Others	3	1	
Highest position within NCCR project (%)	Director or deputy director	7	3	.07*
	Project leader	55	62	
	Other (collaborator etc.)	39	35	
Number of accepted SNSF projects before NCCR		3.9	2	21.3**
Number of pre-proposals		1.21	1.23	.43

How do women and men compare in terms of social status and reputational capital in 1999? Table 2 shows that there is an inverse proportion of professors and non-professors in favour of men. Moreover, the participating women are significantly younger than the men. They come significantly more often from the social sciences and humanities than men, who in turn are over-represented in the natural sciences and engineering. Accordingly, women are over-represented in universi-

[5] For all variables except the number of accepted SNSF projects (mean test), Cramer's V was used to measure the association between variables.

ties and men are over-represented in the two Swiss Federal Institutes of Technology (ETH). Sex is also correlated with the highest position attained in pre-proposals: men hold significantly more leadership positions than women. Men also benefit from significantly more reputational capital with the SNSF than women (twice as many projects funded). Overall, the data confirm the distinct and, on many accounts, unequal positions women and men occupy in the scientific field. Do these differences and inequalities have an effect on the outcome of the contest, i.e. getting funded?

Table 3 presents three regression models; the coefficients it contains are odds ratios. Model A considers the effect of sex without any other variable included. It shows that sex is indeed very significantly related to the likelihood of getting funded. We may add that this effect is next to inexistent when analysed with respect to the three other indicators of success that are related to earlier stages in the selection process (see also table 1). Model B adds disciplines, reputational capital, and networking (multiple participation) as independent variables. These three variables have again significant effects on the likelihood of funding. For researchers from the natural sciences, engineering, biology and medical sciences, the likelihood of receiving funding is more than three times higher than for researchers from the social sciences and humanities.[6] Reputational capital as a researcher is also statistically significant. Individuals with more reputational capital have a much higher chance of being funded. Strategic action works as well: individuals involved in more than one pre-proposal have a higher chance of getting funded.

Since almost all of these indicators are correlated with sex, as Table 2 shows, they may mediate the effect of sex on the likelihood of being funded. In other words, they may be considered as mechanisms accounting for the effects of sex. Indeed, this is what model B shows dramatically: if these variables are included, the effect of sex as such becomes insignificant.

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[6] Let us add that even if no fundamentally social or human science NCCR was funded, some individual scholars from these disciplines did nevertheless participate in NCCRs based in other disciplines, which makes it possible to compare them to scientists of other disciplines in the 1999 contest.

Table 3 Regression of funding on sex and other indicators of social status (1999, odds ratios)

		Model A Sex only	*Model B* Sex, discipline and reputational capital	*Model C* Sex + all other variables
Sex	Male	--	--	--
	Female	.55**	.67	.69
Discipline				
	Social sciences and humanities	--	--	--
	Natural sciences and engineering		3.7**	3.2**
	Biology and medical sciences		3.0**	2.9**
	Missing		1.9**	.95
Number of accepted SNSF projects before NCCR		--	1.04**	1.05**
Number of pre-proposals	One	--	--	--
	More than one		2.16**	2.4**
Academic status	Professor	--	--	--
	Non professor			.84
	Information missing			.68
Age	under 45	--	--	--
	over 45			.69**
	Missing			.78
Highest position within NCCR project	Director or deputy director	--	--	--
	Project leader			1.2
	Other (collaborator etc.)			3.2**
DF		1	5	12
Block chi-square		7.73**	91.9**	33.1**
Model chi-square		7.73**	99.7**	132.8**

Legend: Odds ratios express the probability of members of a category in an independent variable (e.g. age over 45) to be more or less successful than members of the so-called reference category (indicated by --, in this example age under 45). An odds value of 1 means the same probability, odds higher than 1 mean an increased probability, odds lower than 1 a reduced probability. The asterisks indicate the significance of the odds ratio, similar to table 2.

In other words, these results suggest that women received funding less often not so much directly because of their sex, but because, first of all, they were over-represented in the social sciences and humanities, and, secondly, because they had less reputational capital. Formulated differently still, this would mean that they did not suffer discrimination in the selection process itself but were handicapped

by discrimination of various kinds that had affected their earlier biographical trajectories. We will comment on another form of - indirect - discrimination later: the selection of NCCRs from disciplines with little female participation in the fourth stage had of course a negative effect on women's final success.

Inclusion of the additional variables in model C does not change the overall picture. Younger researchers and individuals with a "collaborator or other" position have had a higher chance of being funded, whereas academic status shows no significant relation. Those variables, although they have a significant effect on funding, do not account for the inequalities between men and women for funding.

4.2 Women and men in the 2004 contest

Do we find similar trends in 2004? We need to remember that this second competition only concerned the social sciences and humanities. Scholars from other backgrounds could participate only if they were included in projects associated with the social sciences and humanities. This restriction had far-reaching effects on several aspects of how the field was structured. Firstly, the number of individuals, pre-proposals and individual projects was significantly lower in 2004 than in 1999; hence, we are dealing with a much smaller "world" in 2004 than in 1999, and with a more specific one. As a consequence, the number of disciplines involved is much smaller as well. Secondly, the percentage of women participating is higher than in the previous round, given the sex-typing of these disciplines.

Table 4 Indicators of success by sex (2004)

	Men	Women	Cramer's V
N =	*449*	*129*	
% who got a grade « A » on pre-proposals	19	15	.03
% who participated in a full proposal	52	57	.04
% whose full proposal was eventually funded	17	16	.01

Thirdly, the reputational capital of participating individuals is significantly lower than in 1999. The universe of the second round is therefore smaller, more homogenous, with a greater participation of women. How does this affect the gender outcome of the selection process?

Table 5 Indicators of social status by sex (2004)

		Men	Women	Cramer's V
Academic status (%)	Prof.	81	72	.05
Age (%)	-35	3	5	.12
	36 – 45	28	33	
	46 – 55	39	46	
	56 – 65	28	15	
	+65	2	1	
Discipline (%)	Social sciences	53	58	.06
	Humanities	25	24	
	Others, mixed	23	18	
Status of home institution (%)	University	92	92	.12
	Fed. Inst. Technol. (ETH)	4	1	
	Autonomous institute	2	3	
	University of applied science	2	2	
	Other	1	3	
Highest position within NCCR project (%)	Director or deputy director	16	12	.07
	Project leader	64	72	
	Other (collaborator etc.)	20	16	
Number of accepted SNSF projects before NCCR		3.1	2.1	6.9**
Number of pre-proposals		1.24	1.21	.26

Table 4 shows that women and men are not significantly different with regard to any of the three indicators of success. In other words, the proportion of women and men whose projects got a grade "A", who participated in a full proposal and who were eventually funded, are statistically indistinct[7].

[7] There are only three such indicators in 2004 because all the full proposals considered apt for funding by the SNSF were effectively accepted for funding, so there is no point in distinguishing between indicators 3 and 4 as we did for 1999.

Table 6 Regression of funding on sex and other indicators of social status (2004, odds ratios)

		Model A Sex only	*Model B* Sex + discipline and reputational capital	*Model C* Sex + all other variables
Sex	Male	--	--	--
	Female	.97	1.0	.91
Discipline	Social sciences	--	--	--
	Humanities		1.29	1.33
	Other, mixed		.79	.95
	Missing		.58	.73
Number of accepted SNSF projects before NCCR		--	1.0	1.03
Number of pre-proposals	One	--	--	--
	More than one		1.36	1.09
Academic status	Professor	--	--	--
	Non professor			1.26
	Information missing			.77
Age	under 45	--	--	--
	over 45			.84
	Missing			1.27
Highest position within NCCR project	Director or deputy director	--	--	--
	Project leader			1.56
	Other (collaborator etc.)			.05**
DF		1	6	12
Block chi-square		.13	6.06	38.3**
Model chi-square		.13	6.07	44.4**

Legend: Odds ratios express the probability of members of a category in an independent variable (e.g. age over 45) to be more or less successful than members of the so-called reference category (indicated by --, in this example age under 45). An odds value of 1 means the same probability, odds higher than 1 mean an increased probability, odds lower than 1 a reduced probability. The asterisks indicate the significance of the odds ratio, as in Table 2.

In addition, as Table 5 shows, there are almost no differences between men and women as regards academic status, age, discipline, status of the institution, and the highest position in the NCCR project, as well as for the number of participations in distinct pre-proposals. The only statistically significant difference concerns the number of SNSF projects obtained before the race started: men have somewhat more reputational capital than women do, but the difference is not as great as it was in 1999, which is probably due to the stronger presence of women in the disciplines concerned, as already mentioned. Therefore, there is a huge gap

with respect to gender inequalities between the 1999 and the 2004 contests: the field of the social sciences and humanities appears to be much less structured by gender inequalities than the overall field of sciences that expressed itself in the 1999 contest.

Sex is not the only variable that loses its statistical significance for explaining funding. Models A to C of Table 6 reveal that neither discipline, age, academic status, the highest position with the NCCR pre-proposal, reputational capital, nor number of participations has a significant effect on the likelihood of funding in 2004. None of the factors that were significant in 1999 is still significant in 2004. It would appear that none of the traditional factors associated with scientific performance can explain the 2004 results. The lack of an effect of reputational capital is especially striking.

4.3 Women and men in collaborative networks (1999 and 2004)

In the context of NCCRs, the issue of social capital or networking boils down to knowing whether women are less central than men in the collaborative scientific network, a factor which might partially explain the imbalance in funding success in the 1999 contest and merits special attention. Graphs 1 to 4 (see annex) give a visual presentation of the ties that existed between individuals depending on their participation in common pre-proposals. The visualisation of affiliative networks (Wasserman and Faust 1994) is done using Pajek, a programme that analyses and visualises large networks (Batagelj and Mrvar 2004).

Each pre-proposal can be considered as forming an affiliative network, grouping together a certain number of researchers out of the virtual total of researchers that are formally eligible[8]. There is then a relation between pre-proposals and individuals that can be presented in a non-square matrix with individuals in rows and pre-proposals in columns. This matrix can be transformed into a square matrix in which individuals constitute the rows and columns. The cells include the number of pre-proposals in which any two individuals participate jointly. This matrix allows one to build up a network in which the individuals are the nodes and the projects are the arcs. An alternative is to build a square matrix in which pre-proposals constitute the rows and columns. The cells then include the number of individuals

[8] We limit ourselves to a short non-technical presentation of affiliative networks here. See Wasserman and Faust 1994, or Faust 1997 for a detailed discussion of such networks.

shared by any two pre-proposals. This matrix can be visualised as a network in which the pre-proposals are the nodes and the individuals they share are the arcs. These two perspectives allow us to look at a) the network of individuals who are associated because they are participating in common pre-proposals, or at b) the network of pre-proposals associated by the participants they have in common. In this contribution, we concentrate on the network of collaborating individuals. A more detailed description can be found in our aforementioned unpublished report (Widmer et al. 2005).

Graphs 1 and 3 present the distribution of male and female researchers among the pre-proposal groups in the two runs. Clusters of individuals in the graphs belong to the same pre-proposal. Intermediate individuals between two clusters participate in two or more pre-proposals. These graphs show that, both in 1999 and in 2004, women are as integrated as men in the overall network of collaboration,.Women researchers do not form isolated clusters; they collaborate with others as much as men do.

Comparing Graphs 1 and 2 (sex distribution and funding in 1999), we see, however, that funding concerns more "male" than "female" nodes. This is another illustration of the fact that the social sciences and the humanities, with a higher proportion of female participants, were under-funded in 1999; the right-hand part of the graph - with more women and less funding - actually represents proposals from these disciplines. For 2004, i.e. Graphs 3 and 4, the pattern of funding is very different: funding is over-represented on the fringes of the graph: its centre was obviously neglected by funding decisions (Graph 4). Whatever the reasons for this intriguing finding, it seems to have little to do with gender differences. For possible interpretations, see Widmer et al. (2005).

These results allow us to look separately at what we could term *individual* and *collective gendering*, i.e. the sex of the individual researchers and the sex composition of the proposal groups in which they participated (not shown in the graphs). It indicates that both have an effect on funding. The general trend is that female-skewed projects have lesser chances to get funded than male-skewed ones, and an individual's sex also diminishes these chances, and these two characteristics seem to have independent effects. An intermediate proportion of women is associated with no individual sex differences, whereas higher as well as lower proportions are linked to strong differences – maybe this intermediate level indicates a situation whereby female participation is mainly the participation of token women. It could also be that gender-balanced projects are anchored in gender-balanced dis-

ciplines where membership of one or the other sex plays a more insignificant role. We are not able to clearly interpret this indication as we have not examined it more closely. But our regression results indicate that, at both levels of gendering, the mechanisms producing the sex differentials are not related to the factors inherent to the NCCR selection process, but to career obstacles encountered prior to the academic contests we analyse.

4.4 Summary

Overall therefore, we find that the manifest disadvantage of women researchers - especially in the first NCCR round - is mainly explained, at this stage, not by their belonging to the female sex but rather by the various forms of inequality in the gender-selective functioning of the scientific system prior to participation in funding contests; This is especially due to women being concentrated in discriminated disciplines as we postulated in our second hypothesis (with sex-typed preferences also certainly playing a role in the early stages of biographical orientation), and by their resulting lower reputational capital (fourth hypothesis), probably as a result of processes of cumulative disadvantage as we postulated in our first hypothesis; interestingly enough, it is not because they reached a lower rank in the academic hierarchy (our third hypothesis). The differences between Tables 2 and 4 concerning the sex differences of academic status in the two rounds indicate that in humanities and social science projects (2004), female researchers are more easily integrated on a par with their male colleagues, whereas in natural and technical science projects (1999), their integration tends to institute a hierarchical differentiation between the sexes. This may also reflect the stronger, longer presence of women and their greater upward mobility in the humanities and social sciences compared to the natural and technical sciences, and once more corresponds to our second hypothesis.[9]

The specific and intriguing finding that only in the 1999 contest - not in 2004 – was the women's success rate lower in the last phase of the selection process is most probably due to the elimination of humanities and social science projects in this very last phase of the 1999 contest. The question about the reasons for this elimination provoked much heated debate when it was announced, and it does not

[9] However, as Dubach's contribution (part of this book) implies, an important part of women's higher professorial success rate in these disciplines in Switzerland is due to academic immigration rather than upward mobility within the country.

seem that much easier to explain it even now, with greater hindsight. Even though the "soft science" projects were maybe already judged less positively by the SNSF experts in earlier phases of the overall process, it should not be overlooked that the last and practically complete bias was introduced between phase 3, i.e. the SNSF proposal for funding (18 projects, of which 3-4 were from the social sciences or humanities) and phase 4, i.e. the actual funding decision that was taken on the political level, i.e. outside the SNSF (14 projects with 0-1 from the social or human sciences).[10] The ultimate, political decision was officially taken by the Federal Council. It will have been significantly influenced by the priorities expressed by the various university authorities, since it was taken after a round of meetings between the State Secretary for Education and Research and the presidents (rectors) of the respective universities. It seems therefore likely that the eventual dropping of human and social science projects from the 1999 contest can be attributed to the university management's disciplinary preferences at the time; it was linked to a traditional prestige granted to "hard" and "soft" sciences and to their purported economic utility. Differential gender concentrations in the academic disciplines may not have been the cause of these decisions, but their relationship with the respective prestige of scientific disciplines cannot be considered accidental; rather, it expresses a basic element of the existing gender order within science. Whatever the reasons, the dropping of the "soft science" NCCR proposals from the first selection process had a clear discriminatory side-effect on the participation of women researchers in the NCCRs.

Another intriguing finding is the insignificance of classical indicators of scientific quality to explain success in the second evaluation process. This aspect is related less to the subject of this contribution, but to the potentially different logic inherent in scientific quality judgements. Although our findings are too sketchy to permit any well-founded interpretation, an obvious hypothesis (more in line with Snow's "two-culture" thesis (1959) than many of us may be comfortable with) could be that the classical indicators of scientific value that were helpful to explain success in the 1999 round are appropriate for the natural sciences but much less so for the human and social sciences. We can suppose that the experts appointed for the 2004 contest on the basis of the disciplines that were represented

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[10] The imprecision of the given figures is related to the somewhat controversial classification of one of the accepted NCCR projects as predominantly social or natural science (political actors insisted on its social science character in order to shun the argument that no social or human science project had been accepted), but this "uncertainty" is of no fundamental consequence for our findings.

in the second round used the less formal criteria considered appropriate to these disciplines at the time; and that these have little correlation with the more formal criteria we were able to use on the basis of available information.

5. Discussion: What should be done?

What might help to reduce the inequalities between men and women in scientific achievement? One first recommendation that could be derived from our research is to *increase the share of the social sciences and humanities* in the overall budget of SNSF (let us recall that for a long time Division I (Human and social sciences) has only had about half the budget of each of the other two "hard science" divisions). This reflects a long-standing tradition regarding the financial endowment of the three basic divisions, but is hardly in line with the SNSF statutes that proclaim equal treatment of all disciplines[11]. The 1999 contest clearly shows that disciplines grouped in Divisions II (Natural and technical sciences) and III (Biological and medical sciences) have a much more gendered logic that structures their scientific field in numerous ways.[12] Funding is the most obvious one. But it has its roots in the unequal distribution of women and men across disciplines and age groups (perhaps academic statuses as well, although our results did not show any clear results in this respect). In the social sciences and the humanities, a different logic, with less hierarchical differentiation between the sexes, seems to be at work.

A second issue would be to tackle the various components of the discipline-specific *logic of sex differentiation*, starting with the popular sex-typing of occupations, including scientific disciplines. It is a central factor that pre-shapes individual biographical projects as well as being the logic that subtends guidance from various biographical agents (parents, teachers, vocational councillors, etc.), and is prolonged by the various cultural and structural obstacles that discourage women from pursuing a scientific career. Hierarchical sex differentiation (leaky pipeline) is still a striking by-product of how universities work and needs to be explicitly addressed.

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[11] Article 2, paragraph 1 ends with the statement that all disciplines are to be considered equally.

[12] This observation is clearly confirmed by the internal gender monitoring of the running NCCRs (unpublished documents of SNSF Div. IV).

A third issue is related to *reputational capital*. Both in 1999 and in 2004, men turned out to have more reputational "power" than women. In 1999, this inequality had a profound effect on the likelihood of someone receiving funding. This was not the case in 2004. How and with how much weight should records of past funding - and probably publications - be taken into account when judging a scholar's projects? What other indicators of scientific quality should be considered that are more appropriate to the human and social sciences? This is a very serious issue that has direct consequences on sex inequalities in the sciences - all the more so as current, rather formal indicators of "scientific quality" are also used by other funding instances as a basis for funding allocation to research projects in particular and academic institutions in general.

A fourth issue is about *networking and social capital*. We did not find any female enclaves or ghettos (women's worlds) when we looked at the connections there are between participating scientists. Quite the opposite. Further statistical analyses, based on various centrality indices, reveal that women occupy as central a position as men in relational terms in both the 1999 and 2004 contests. This should of course not be seen to contradict continuing efforts to reinforce women's networking in the scientific field, but it could indicate that these efforts are already bearing fruit.

References

Batagelj, Vladimir & Andrej Mrvar. 2004. *Pajek. Program for Analyzing Large Networks*. Software available on the Web at: http//vlado.mat.uni-lj.si/pub/networs/pajek/.

Bourdieu, Pierre. 1980. „Le capital social: notes provisoires." *Actes de la Recherche en Sciences Sociales* 31:2-3.

Coleman, James (1988), „Social Capital and the Creation of Human Capital. " *American Journal of Sociology* 94 (special issue):95-121.

Faust, Katherine 1997. „Centrality in Affiliation Networks. " *Social Networks* 19, 157-191.

Hosmer, David W. & Stanley Lemeshow. 1989. *Applied Logistic Regression*. New York: John Wiley and Sons.

Merton, Robert K. 1973. *Sociology of Science*. Chicago University Press, Chicago.

Portes, Alejandro. 1998. „Social Capital: Its Origins and Applications in Modern Sociology. “ *Annual Review of Sociology* 24:1-24.

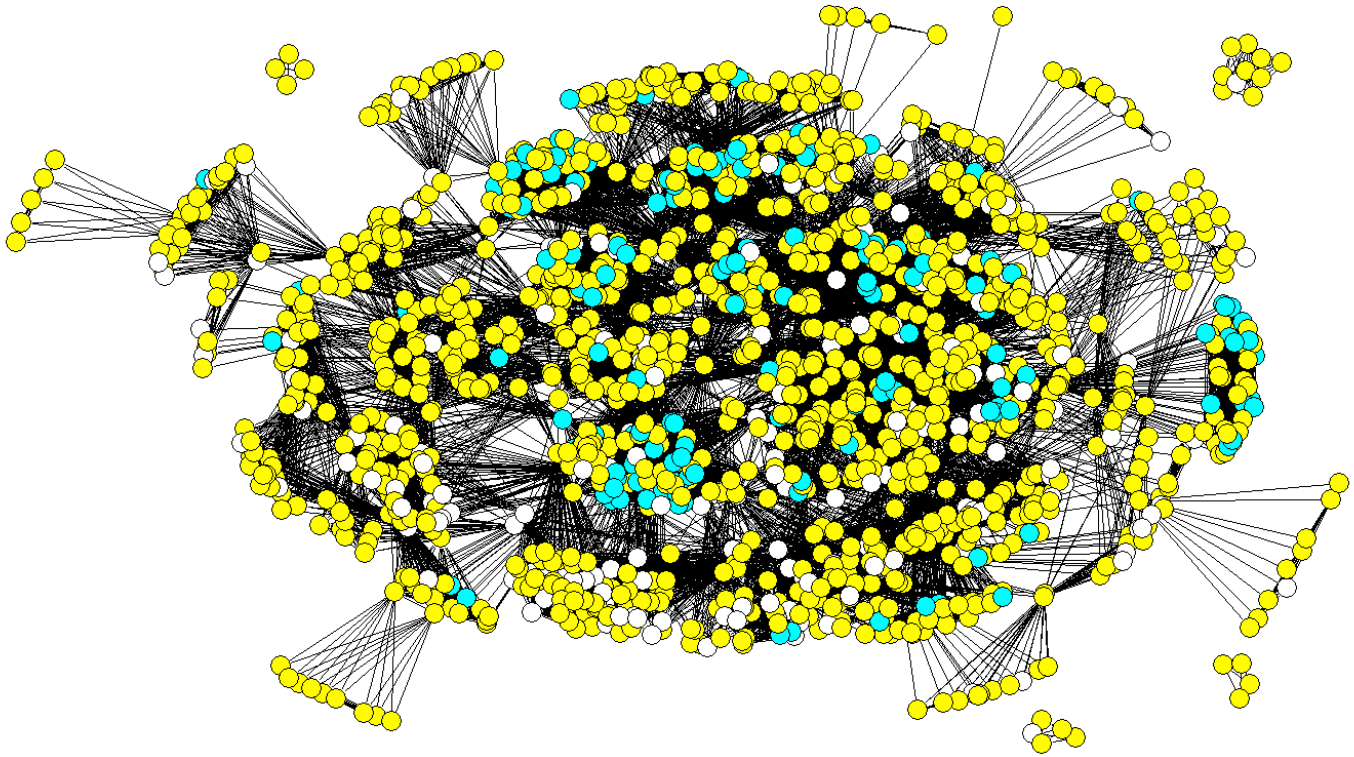
Snow, Charles P. 1959. *Two Cultures.* Cambridge University Press, Cambridge.

Wasserman, Stanley & Katherine Faust. (1994), *Social Network Analysis: Methods and Applications.* Cambridge University Press, Cambridge.

Widmer, Eric, René Levy & Francesco Giudici. 2005. Pôles d’excellence et réseaux de collaboration dans les sciences en Suisse: Une analyse réticulaire. Université de Lausanne.

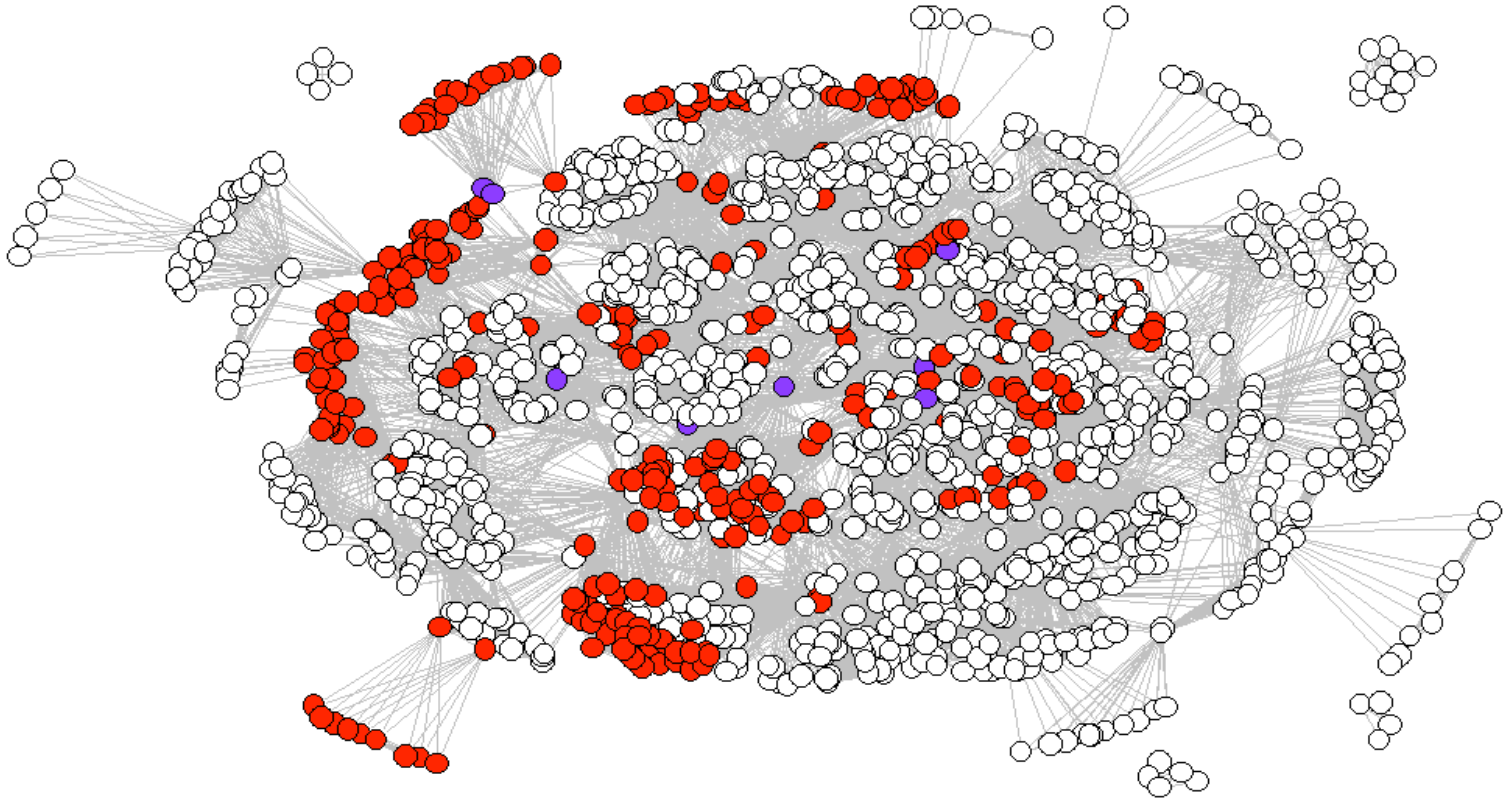
FIGURES

Figure 1 Overall network of collaboration among individuals according to sex (1999)



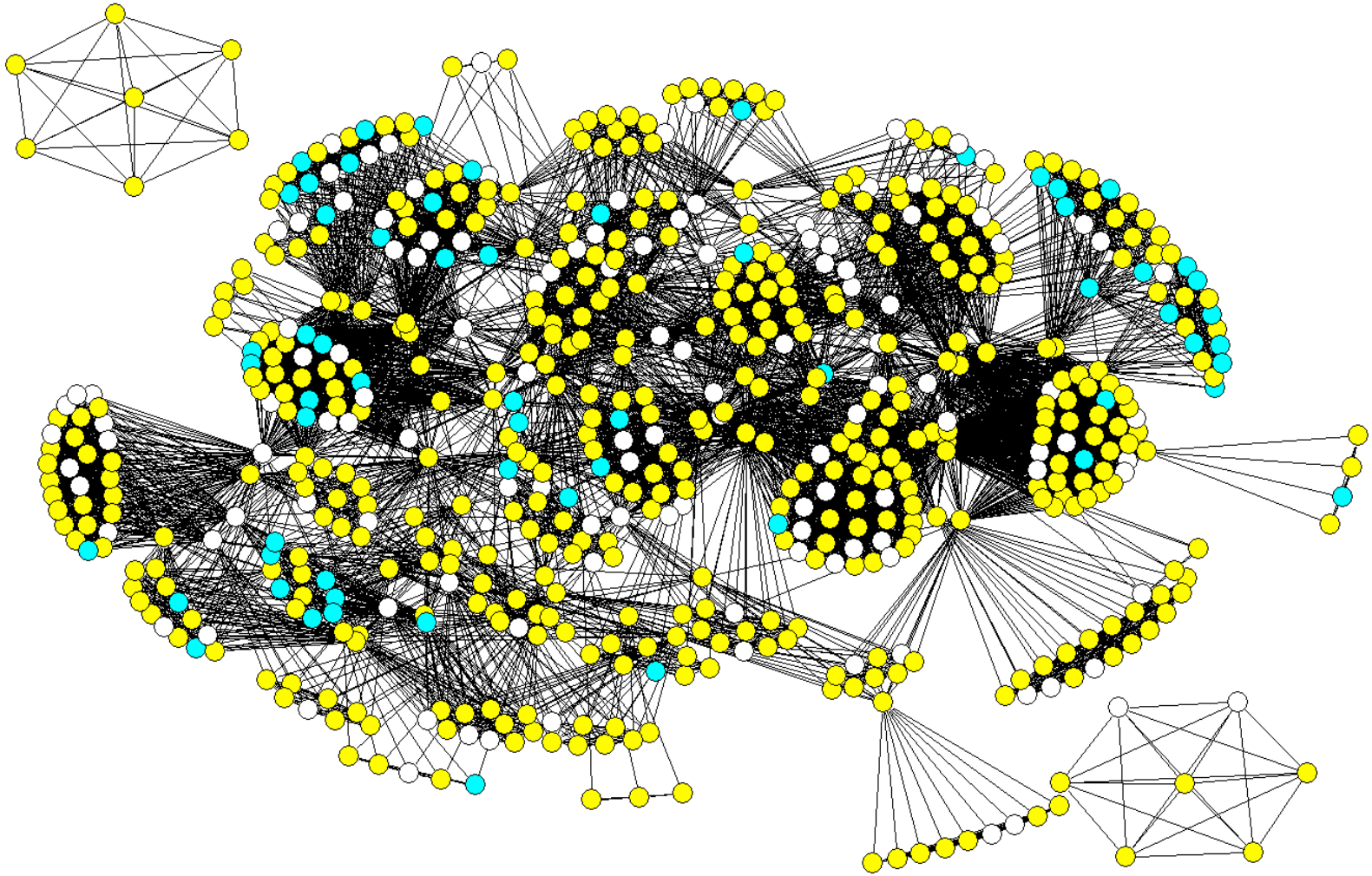
Yellow: men / Blue: women / White: unknown

Figure 2 Overall network of collaboration among individuals according to funding (1999)



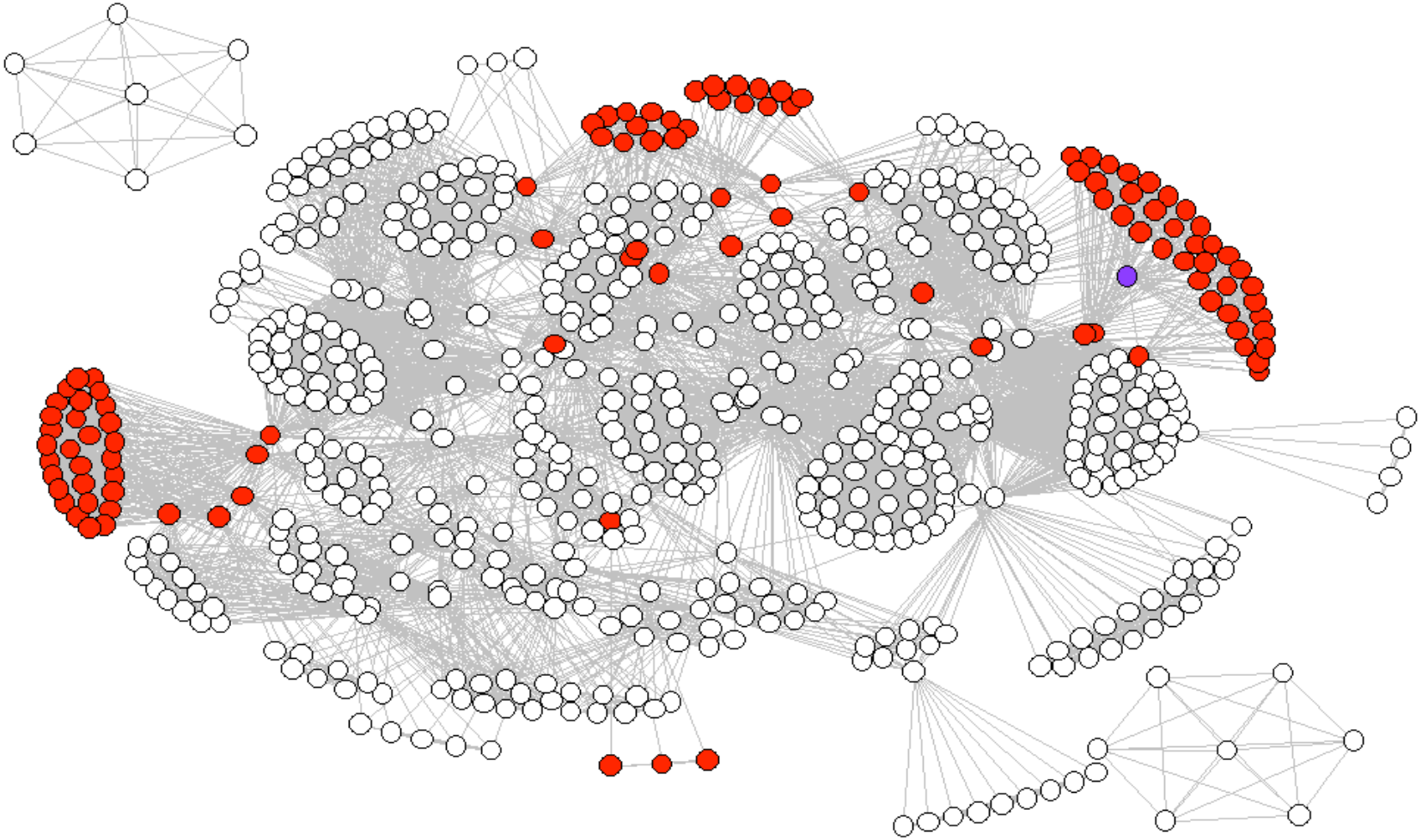
Black: Two or more projects funded / Gray: One project funded / White: not funded

Figure 3 Overall network of collaboration among individuals according to sex (2004)



Dark gray: men / Light gray: women / White: unknown

Figure 4 Overall network of collaboration among individuals according to funding (2004)



Black: Two or more projects funded / Grey: One project funded / White: not funded