

ANNEX 9

Interdisciplinary Research within the Research Grants Program

Summary of the Report for AGIR, Advisory Committee on Interdisciplinary Research

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At the request of the Advisory Group on Interdisciplinary Research a statistical analysis was done to compare interdisciplinary research to discipline-based research within the Research Grants Program. The study explores differences in the success rates and in the average grants between disciplinary-based research and interdisciplinary research.

The data set includes data on principal investigators that have applied to Research Grants Individual or Group, and to Subatomic Physic Individual, Group and Project, between 1997 and 2000 inclusively. For the purposes of this study, three interdisciplinary groups have been defined, then compared to a disciplinary group. The three interdisciplinary groups are 1) applicants to GSC 21¹ 2) all applicants to GSC 21 plus cases of cross-consultations from other committees 3) applicants that indicated cross-disciplinary coding in their applications. A cross-disciplinary coding appears when the primary research subject code and the secondary research subject code refer to two different disciplines or series. For example, robotics (series 2600) is different from electrical and electronic engineering (series 2500). The cross-coding of these codes would be considered as interdisciplinarity.

Table 1 presents a breakdown of the number of cases for each group. It should be noted that these groups are not mutually exclusive. The first group includes all applicants, and it is used as a point of reference. There is also an overlap between the three interdisciplinary groups.

V. Table 1 - Distribution of Cases for Each Group

Competition year	1997	1998	1999	2000
Total all applicants	2702	2614	2623	2943
GSC 21	43	44	39	30
(% of total)	(1.6%)	(1.7%)	(1.5%)	(1.0%)
Cross-consultations	253	288	221	246
(% of total)	(9.4%)	(11.0%)	(8.4%)	(8.4%)
Cross-disciplinary coding	1123	1213	1300	1285
(% of total)	(41.6%)	(46.4%)	(49.6%)	(43.7%)

Members of the AGIR committee wanted to address some particular issues:

- How does interdisciplinary research fare, in comparison to discipline-based research?
- What are the demographic characteristics of interdisciplinary researchers?
- How are interdisciplinary renewals treated in peer review?
- How do interdisciplinary first renewals do when compared to other first renewals?
- Whether the disciplinary profile of applicants and grantees is different within a grant selection committee?

Most of these questions are handled in this report. An analysis of the volume of applications provides trends of interdisciplinary research between 1997 and 2000. The demographic profile of interdisciplinary research applicants is explored using position title, gender, and year of Ph.D. graduation. The relationships between each demographic variable, the success rates, and the average grants are analysed. Finally, a description of

¹ Grant Selection Committee 21, Interdisciplinary Research.

the disciplinary profile of research for both, successful and unsuccessful applicants completes the study. A summary of findings follows.

Success Rate

The main finding is that interdisciplinary research, in general, has a lower success rate than the group of disciplinary-based research. This difference is significant but very weak, Cramer’s V indicates a weak to nil relationships ($V=0.116$; $p<0.001$), when all the data is pooled. In other words, interdisciplinary research has a lower success rate, but this phenomenon is not particular to GSC 21. As shown in Table 2 below, cross-consultations and cross-disciplinary coding also present lower success rates than disciplinary research.

Table 2 – Success Rate for Interdisciplinary groups, 1997-2000²

	<u>Interdisciplinary groups</u>		<u>Disciplinary groups</u>		χ ²
	N grantees	(%) success rate	N grantees	(%) grantees	
GSC 21	93	(59.6)	8056	(75.1)	19.6***
Cross-consultations	595	(59.0)	7554	(76.5)	148.5***
Cross-disciplinary coding	3576	(72.7)	4573	(76.7)	23.5***

Bilateral Test: *= $p<0.05$ **= $p<0.01$ ***= $p<0.001$

There is a lot of variation in the success rates from one committee to the other and from year to year. Table 3 presents a summary of the statistics for each committee. Interdisciplinary research is defined here as cross-consultations cases. On the whole, few committees present a significant association for the success rate. Significant tests are isolated cases and no conclusions can be drawn for committees in general. This table tends to corroborate the very weak association found in the population earlier.

² Only statistics for grantees are presented. Total number of grantees = 8,149.

Table 3 – Comparison of Success Rates By committee, 1997-2000

	Success Rates (%)				Difference	χ ²	P
	Discipline-based	(N)	Cross-consultations	(N)			
GSC 03	64.2	(330)	64.0	(16)	-0.2	.000	.984
GSC 04	89.7	(479)	87.5	(21)	-2.2	.119	.730
GSC 06	74.3	(511)	42.9	(6)	-31.4	.6.977**	.008
GSC 08	83.3	(269)	78.9	(15)	-4.4	.239	.625
GSC 09	67.6	(296)	53.3	(24)	-14.3	3.704	.054
GSC 12	72.0	(342)	61.9	(26)	-10.1	1.917	.166
GSC 13	86.3	(522)	64.0	(16)	-22.3	9.557**	.002
GSC 14	89.9	(246)	100.0	(10)	+10.1	1.134	.287
GSC 17	87.1	(162)	85.7	(6)	-1.4	.011	.915
GSC 18	72.2	(466)	62.2	(23)	-10.0	1.754	.185
GSC 19	79.2	(194)	40.0	(2)	-39.2	1.754	.185
GSC 20	88.8	(231)	90.9	(10)	+2.1	.046	.831
GSC 21 ³	---	---	56.9	(93)	---	---	---
GSC 24	76.8	(322)	65.0	(26)	-11.8	2.796	.094
GSC 26	78.0	(302)	75.6	(34)	-2.4	.144	.705
GSC 28	84.7	(216)	73.3	(14)	-11.4	1.594	.207
GSC 29	87.7	(128)	92.0	(23)	+4.3	.387	.534
GSC 30	55.2	(202)	40.3	(25)	-14.9	4.706*	.030
GSC 31	45.6	(182)	26.7	(24)	-18.9	10.814***	.001
GSC 32	62.1	(251)	48.7	(56)	-13.4	6.685**	.010
GSC 33	57.1	(190)	33.9	(20)	-23.2	10.807***	.001
GSC330&331	88.2	(614)	69.7	(23)	-18.5	1.471**	.002
GSC 334	92.5	(347)	83.9	(26)	-8.6	.2.877	.090
GSC 335	83.3	(280)	80.0	(20)	-3.3	.184	.668
GSC 336&337	82.7	(472)	81.8	(36)	-0.9	.020	.887

Bilateral Test: *= $p < 0.05$ **= $p < 0.01$ ***= $p < 0.001$

Average Grants

The analysis of average grants by committee indicates that there are differences between the means of each group. In many cases figures tend to confirm the belief that interdisciplinary researchers receive less money than core disciplinary researchers. However, this difference is seldom statistically significant.

When all the data are pooled there are differences between average grants of interdisciplinary and disciplinary researchers. Interdisciplinary research (GSC 21 plus cross-consultations) is slightly disadvantaged (\$26,912.81 versus \$27,761.01 for discipline-based research). However, on a yearly basis, the situation has been improving over time. While the difference was about \$3,000 in 1997, it is only \$700 in 2001. Table 4 presents the average grants and mean differences for discipline-based groups and cross-consultation groups for each committee. T-test values and significance levels are also displayed. Cross-consultation groups have either a lower average grant or a higher average grant than discipline-based groups. Difference of average grants is statistically significant for four committees.

³ All cases received cross-consultations.

Table 4 – Comparison of Average Grants By Committee, 1997-2000

	Average Grant (\$)				Average all applicants (\$)	Mean Difference (\$)	t	P
	Discipline-based (\$) (N)		Cross-consultations (\$) (N)					
GSC 03	34003	(330)	32157	(16)	21772	-1845	.421	.674
GSC 04	29841	(479)	22528	(21)	26464	-7313	5.918***	.000
GSC 06	23689	(511)	20846	(6)	17422	-2843	.640	.523
GSC 08	31960	(269)	25637	(15)	26263	-6324	1.229	.220
GSC 09	25332	(296)	19408	(24)	16489	-5924	1.995*	.047
GSC 12	25835	(342)	26310	(26)	18413	+474	-.156	.876
GSC 13	22716	(522)	20975	(16)	19354	-1741	.630	.529
GSC 14	15185	(246)	18932	(10)	13819	+3748	-1.394	.165
GSC 17	32933	(162)	39742	(6)	28878	+6809	-.711	.478
GSC 18	28705	(466)	29925	(23)	20623	+1220	-.340	.734
GSC 19 ⁴	30344	(87)	43837	(2)	23313	+15278	3.160**	.006
GSC 20	19612	(231)	22115	(10)	17533	+2504	-.760	.448
GSC 21 ⁵	---	---	23301	(93)	13891	---	---	---
GSC 24	46521	(322)	44505	(26)	35157	-2016	.404	.686
GSC 26	41781	(302)	36722	(34)	32098	-5059	1.168	.244
GSC 28	30672	(216)	24505	(14)	25431	-6167	1.164	.246
GSC 29	30791	(128)	23724	(23)	26239	-7067	1.714	.089
GSC 30	28566	(202)	28650	(25)	15155	+84	-.028	.977
GSC 31	35630	(182)	36487	(24)	15052	+858	-.208	.835
GSC 32	33531	(251)	33316	(56)	19811	-219	.103	.918
GSC 33	38488	(190)	35467	(20)	20464	-3020	.751	.454
GSC330&331	23467	(614)	21042	(23)	2049	-2424	.879	.380
GSC 334	23125	(347)	23061	(26)	21241	-64	.029	.977
GSC 335	25143	(280)	20016	(20)	20611	-5127	3.632**	.001
GSC 336&337	15021	(472)	13703	(36)	12330	-1318	.981	.374

Bilateral Test: *= $p < 0.05$ **= $p < 0.01$ ***= $p < 0.001$

Trends of Volume of Applications

Trends of volume of applications for interdisciplinary research is linear, indicating a relatively stable percentage in the volume of applications over the period 1997-2000. It should be noted that interdisciplinary research represents only about 10% of applications, as per administrative definition (GSC 21 plus cross-consultations).

The attrition rate for grantees of grant selection committee 21 is neither higher nor lower than attrition rate for grantees from other disciplines. The time it takes for the number of supported grantees to be reduced by one-half is roughly 11 to 12 years for GSC 21, about the same period of time as for other disciplines. In fact, applying to GSC 21 seems to have no particular consequences on the granting history of researchers. Another interesting point is that individuals in the system do not necessarily start their granting history with GSC 21. They rather come to GSC 21 at one point in their career, after being in the system for a certain period of time. For this reason, the attrition rate really is the period of time a candidate remains in the program.

⁴ SAPGP and SAPPJ excluded.

⁵ All cases received cross-consultations. Comparison of GSC 21 with all other committees produces the following results: GSC 21=\$23301; All others=\$30446; Mean difference=-\$7145; t=1.428; df=8147; p=0.153.

Demographic Profile

An increasing number of assistant professors and young researchers are involved in interdisciplinary research, more than any other categories of applicants. There is a very weak association between the faculty position and the success rate; professors have a higher success rate than any other categories.

In spite of the fact that new researchers receive less money overall than established researchers do, one cannot conclude that the higher percentage of new researchers totally explain the lower average grants for GSC 21 and GSC 21 plus cross-consultations. Established researchers also receive less money from GSC 21 and GSC 21 plus cross-consultations.

There is a very weak association between gender and success rate in the population. In contrast, there is no association in GSC 21 and GSC 21 plus cross-consultations. In fact, gender has no direct effect on the success rate. Gender and experience combined together have an effect on the faculty position occupied by applicants, which eventually has an effect on the success rate. Men seem to have a higher success rate in general because success rate is directly linked to the hierarchy of faculty position; the higher the faculty position, the higher the success rate. If the success rate of men seems to be higher than the success rate of women, it is only because there are more men in higher position than there are women.

There is no significant difference of average grants between men and women in the particular group of GSC 21 and cross-consultations, but there is a difference in the population in general. The average grants of women are systematically lower than average grants of men are, and this difference is statistically significant. There may be some intermediate variables to explain this difference. For example, one may think of the effect of faculty position on the average grant. While no specific analysis was done by gender, other analysis showed that there is a strong correlation between faculty position and average grant. More analysis would be required to clarify the relationship found.

Disciplinary Profile

Comparison of the disciplinary profile (based on Primary Research Subject Codes) of grantees and all applicants demonstrates no major differences. Both are quite similar confirming that grantees are representative samples of the group of applicants. The same comparison for the competition year 1997 and the competition year 2000 demonstrates no major changes in disciplinary patterns over the four-year period.

Conclusion

From the comparison of interdisciplinary research to the population of applicants or discipline-based research emerges a general finding, the group of applicants to GSC 21 and cross-consultations presents a slightly different profile than the other groups. Interdisciplinary research has a slightly lower success rate, slightly lower average grant, and a particular demographic profile. However, this finding has to be clarified. The

differences found are not always statistically significant, and the actual associations are very weak making it difficult to predict with confidence what the bias may be. This phenomenon may be due to inconsistency in the patterns from committee to committee and from year to year.

On the other hand, the group of cross-disciplinary coding presents a profile similar, in all aspects, to the population in general. This may be due to the large number of cases in that group that emphasizes its similarities to the population. Moreover, there is the fact that many cases in this group are possibly not, in fact, interdisciplinary.

This statistical analysis points to problems that are not particular to GSC 21. Interdisciplinary research may be affected by bias affecting the Research Grants Program in general. More analysis would be required to explore this dimension.