

ACADEMIC ENGINEERS IN QUEBEC:
THE MYTH OF LINGUISTIC DEMARKATION

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by

Thomas O. Eisemon,
Department of Social Foundations
of Education,
McGill University, and

Yakov Rabkin,
Institut d'histoire et de
sociopolitique des sciences,
Université de Montréal.

Introduction

Much attention has been given in studies of science to examining the extent to which scientific work is defined by local political, social and economic conditions, on one hand, and by trans-national concerns intrinsic to the nature of scientific activity, on the other. This issue is of considerable significance to science policy inasmuch as science policies are predicated in part on the belief that patterns of scientific communication and recognition can be shaped in accordance with societal goals. The research reported here considers the efficacy of science policies designed to alter networks of professional communication and recognition through promoting the local language as an alternative medium of scientific training and research. The findings of this study, it is hoped, will provide insights into the influence of language on the attitudes and activities of scientists in relation to the role of science policy and to the nature of scientific work itself.

Quebec was selected as the locus of study for two reasons. First, as a predominantly French speaking province within an English speaking minority, Quebec has sought to preserve its cultural identity through efforts to encourage the use of French as a commercial as well as an educational and professional lingua franca. French has been adopted as the official language of Quebec. It is the medium of higher education in most of the Province's universities. And, the French language has been promoted as a mode of scientific communication and recognition through the science policies of the Provincial, and, to a certain degree, Federal governments. These policies have fostered the development of French language scientific journals, provided financial support to

Francophone scientific societies and helped the national ones to become bilingual, stimulated scientific training and research in French medium universities, and sought to facilitate collaboration with French speaking scientific communities in various areas of the world.

Second, the Province of Quebec contains a significant Anglophone minority. The Anglophone community, with its own educational and scientific traditions, exhibits a close affinity to other parts of English speaking Canada. Quebec is a bi-cultural society, a society often described as "two solitudes" in which the English and French communities function autonomously.

Because of its bi-cultural characteristics, the autonomy of the English and French communities, the efforts to encourage French as a language of scientific communication and recognition, Quebec affords a unique opportunity to study the effects of language on the professional attitudes and activities of scientists. Language is a salient feature of the science policies not only of Quebec but of many other societies.¹ It is central to the science policies of a large number of modernizing countries which, like Quebec, place scientific development in the context of ensuring a degree of local control over the exploitation of their own human and material resources. In this respect, language is seen as a factor mediating foreign scientific influences and as a critical step toward creating a "self-sufficient" local infrastructure of scientific communication and recognition.

Little is known about the outcome of measures to enhance the professional importance of local language. To what extent are linguistic measures successful in affecting the attitudes and activities of

scientists? Do "parochial" language policies serve, for instance, to isolate scientific communities thereby depressing scientific activity and generating demoralization? It is very difficult to provide answers to these questions, except in a speculative sense, due to the need to study autonomous scientific communities which are comparable in terms of the institutionalization of science but which differ in language, and, presumably, in their relation to the international scientific system. Quebec is well suited to such a study.

There are few studies of science and technology in Quebec, consisting mainly of historical essays.² Of relevance to the subject of this study is an interesting paper prepared by Blume in 1974 examining science in a bi-cultural society.³ Blume's paper postulated isolation of the French speaking scientific community in North America. This was exacerbated, he felt, by the lack of professional opportunities for Francophone scientists in Quebec. Opportunities for Francophones in the scientific development of Quebec were among the issues raised at the hearings of the Lamontagne Commission on Science Policy which were held by the Canadian Senate in the late 1960's and early 1970's. The Lamontagne Report not only served as a basis of Canada's science policies in the 1970's but also represents an important record of public debate on science in Canada.⁴

This paper concerns itself with engineers in the academic profession. Compared to other sectors of science policy, engineering occupies, perhaps, a more pivotal role due to its direct link to economic planning. For this reason, engineering has been assigned a high priority in the

science policies of Quebec and other countries seeking to reduce technological (and, hence, economic) dependency through the development of the local scientific infrastructure.

Moreover, since the affiliations of technologists, are more local,⁵ it is widely contended that their activities are essentially oriented to the political, social and economic environment in which they work, engineering is apt to be influenced to a greater degree by science policies formulated to enhance the status of a local language as a medium of professional communication and recognition. Linguistic influences would be particularly apparent among engineers in the academic profession whose responsibility for engineering training and research involves close association with local users of technology as well as with the engineering communities of other countries.

The institutionalization of the engineering communities of French and English Quebec proceeded historically along separate, but parallel, lines. The first Francophone and Anglophone engineering institutions in the Province were founded in the last quarter of the 19th century. French and English language engineering journals, serving academic as well as practicing engineers, appeared shortly afterwards. The first engineering societies at the provincial level were established at the beginning of this century. In brief, the institutionalization of engineering in Quebec permits comparison of scientific communities similar in the development of a scientific infrastructure but differing in language.

The Ecole Polytechnique of the Université de Montréal and the Faculty of Engineering at McGill University have been selected as the focus of this study. These institutions are the oldest, largest and most prestigious engineering institutions in the Province and are known nationally and internationally. Like engineering institutions elsewhere, the Ecole Polytechnique and the Faculty of Engineering began as institutions of applied science training civil engineers for employment in government public work projects. Later, programs in electrical and mechanical engineering were developed and, shortly before the Second World War, new fields such as chemical and aeronautical engineering appeared, reflecting the increasing specialization of the engineering profession. In the past two decades, the emphasis in engineering education at both institutions shifted from undergraduate instruction to graduate training and research. At Ecole Polytechnique, however, this shift occurred more recently.

Method, Population Characteristics and Hypothesis

The study population was limited to professors at McGill and the Ecole Polytechnique: (1) holding full-time appointments in Departments of Civil, Mechanical, Electrical and Chemical Engineering; (2) who did not occupy administrative position, except departmental chairmen; and, (3) were on campus during the Spring term of the 1976 academic year. A total of one hundred and thirty engineering professors were surveyed. Very high response rates were obtained for both groups, 96% at McGill and 94% at the Ecole Polytechnique.

Structured interviews were used to collect data. The interview instruments solicited information about the professional attitudes and activities of faculty. Interview instruments were prepared in English, translated into French and re-translated into English to ensure comparability.

Analysis of the biographical information requested in the interviews (Table 1) indicates that respondents at McGill University and Ecole

Table 1
Population Characteristics

	McGill N-56 %	Ecole Polytechnique N-68 %
1. Age:		
60	7	2
50-59	21	10
40-49	31	31
less than 40	41	57
Chisq=6.5, 3 d.f., p.N.S.		
2. country of birth:		
Canada	25	65
US & Europe	43	19
Other	32	16
Chisq=19.4, 2 d.f., $p < .001$		
3. highest degree:		
B.S.	2	1
M.S.	11	46
Ph.D.	87	53
Chisq=17.8, 2 d.f., $p < .001$		
4. country awarding highest degree:		
Canada	48	57
US	30	30
Europe	20	13
Other	2	
Chisq=2.4, 3 d.f., p.N.S.		
5. rank:		
assistant professor	23	15
associate professor	54	54
professor	23	31
Chisq=1.8, 2 d.f., N.S.		
6. mother tongue:		
English	50	7
French	7	72
Other	43	21
Chisq=50.2, 2 d.f., $p < .001$		

Polytechnique are similar with respect to their age, although those at Ecole Polytechnique are somewhat younger (57% were less than forty years old compared to 41% in this age group at McGill). Respondents at the two institutions were also similar in academic rank. More than half at each institution were associate professors. There were significant differences in other respects, however. Engineers affiliated with McGill University were more likely to have been born abroad. A majority did not speak English as their mother tongue. The Ecole Polytechnique is less cosmopolitan in its recruitment with fewer foreign born, non-French speaking academics represented on its staff. The two institutions seem to be ethnically as well as linguistically autonomous in their recruitment practices. They attract faculty from within the French or the English Canada communities and from abroad, but seldom from the other community.

Insofar as level of training is concerned, substantial differences are apparent in the proportion of holders of doctoral degrees. A significantly higher percentage of McGill professors have earned Ph.D.'s (87% versus 53% for Ecole Polytechnique), a factor which will have to be taken into account in subsequent analysis. Despite variation in the level of training, no significant differences exist in terms of the proportion and distribution of foreign trained staff.

In this study, language of work was presumed to influence the professional activities and attitudes of engineering faculty to the extent that it affects networks of professional communication and opportunities for professional recognition. More specifically,

discrepancy between the language of work and the language of professional communication and recognition was expected to foster isolation, demoralization and professional inactivity. It is thus hypothesized that engineers affiliated with a French medium institution will be less active in research, will have less contact with colleagues in other engineering communities, will feel professionally unrecognized and will be more dissatisfied with their institutional environment than their colleagues in an English medium institution.

Language of Work and Research Activities

To ascertain whether differences exist among engineers at French and English medium institutions vis-à-vis their research activities, information was collected relating to the respondent's publications. Several measures of research activity were derived and oneway analysis of variance was used to test the significance of mean scores for the two groups. It should be noted that very few engineering faculty had never published (4% considering the two groups together) and that there were too few instances of exceptionally high productivity (less than 10% had published more than 30 papers) to seriously bias mean scores in either direction.

Insert Table 2 about here

Differences between respondents at the two institutions were significant for five of the six measures of research activity. With regard to total published research, McGill faculty listed twice as many papers as their colleagues at Ecole Polytechnique. Only for

Table 2

Oneway Anova for Published Research

By Institutional Affiliation

	McGill N=56 Means	Ecole Polytechnique N=68 Means	Significance
Research Productivity:			
1. total published papers	16.6	8.4	***
2. number of papers in English	16.7	6.4	***
3. number of papers in French	< 0.1	2.3	***
4. number papers published in Canadian journals	4.3	3.6	N.S.
5. number papers in U.S. journals	9.5	4.0	**
6. number papers in U.S. and foreign journals	12.9	6.0	**

* p < .05
 ** p < .01
 *** p < .001

research published in Canada do the mean scores not vary significantly.

Yet, the higher productivity of engineers at McGill conceals certain similarities. Although those at McGill publish more in foreign and American journals, the relative proportion of total research which appears in such journals is similar. In other words, the mean number of papers in American engineering journals, for instance, is about half of the mean for total research in both cases. Moreover, while engineers at the Ecole Polytechnique publish fewer papers in English than McGill faculty, they publish nearly three times as many papers in English as they do in French. English is clearly preferred as a language of publication.

The colleague networks of Ecole Polytechnique faculty do not seem to be influenced by language of work either. Respondents were asked whether they circulated manuscripts prior to publication and, if so, to identify the names and institutional affiliation of individuals to whom they sent their manuscripts. Engineers at Ecole Polytechnique reported as much contact with colleagues at English medium institutions as those at McGill ($\chi^2=19$, 1 d.f., p. N.S.). This was also the case with the circulation of pre-prints and re-prints ($\chi^2=64$, 1 d.f., p.N.S.). Thus, it can be tentatively concluded that among engineering faculty in French medium institutions, language of work does not seriously affect scholarly communication with other engineering communities or limit opportunity for international recognition. But it may depress the level of research activity, as hypothesized.

An attempt was made to control with two way analysis of variance for differences between the two institutions in terms of the highest degree obtained by respondents, recalling that a much higher percentage of McGill professors held doctorate degrees. Though the "main effects" of institutional affiliation and highest degree were significant, the "interaction" between them was not for total research, research published in English and the number of papers appearing in U.S. and foreign journals. ($F=1.08$, p N.S.; $p=1.45$, p . N.S., $F=.39$, p .N.S., $F=.48$, p .N.S., respectively). This suggests that the differences in productivity noted above may be due to differences in highest degree rather than to institutional affiliation and language of work.

Attitudes Toward Professional Environment

It was also hypothesized that engineering faculty at Ecole Polytechnique would feel professionally disadvantaged by working in a Francophone milieu, a minority professional culture in North America. Attitudinal statements were developed to elicit views regarding the professional role of French. Professors were requested to indicate the extent to which they agreed or disagreed with each statement. No neutral choice was allowed. Four of the statements most appropriate to the subject of this discussion appear in Table 3 below.

Insert Table 3 about here

Two of the four statements in Table 3 deal with the opportunity of Francophone scholars to obtain recognition and to become well-known outside Quebec. A third statement concerns the scope of professional opportunities in the Province and the fourth pertains to the need for

Table 3

Oneway Anova for Attitudes Toward
Influence of Language Environment
by Institutional Affiliation

	McGill N-56 Means	Ecole Polytechnique N-68 Means	Significance
Statement (low score indicates agreement):			
1. Specialists in my field have few professional opportunities in Québec	2.8	2.9	N.S.
2. accomplishments of francophone scholars in my field overlooked by anglophones in Canada	3.3	3.0	*
3. it is difficult for francophones in my field to become known outside Québec	3.1	2.9	N.S.
4. specialists in my field should be proficient in English and French	2.5	1.8	***
5. Total	11.9	10.6	**

* $p \leq .05$

** $p \leq .01$

*** $p \leq .001$

proficiency in French as well as English. As in the previous section, oneway analysis of variance was used to test the significance of differences in the response to these statements. Low values indicate agreement with the statement, the range being between one and four.

A significant difference is shown for the cumulative score, primarily reflecting differences on two of the statements. Professors at Ecole Polytechnique were more apt to agree that the accomplishments of Francophone scholars in their field were overlooked by Canadian Anglophones and, predictably, that specialists in their field should be proficient in French and English. Except for the fourth statement relating to proficiency in French and English, however, the absolute differences between faculty at the two institutions are very small. Most Ecole Polytechnique faculty do not feel limited by working in a French language milieu, as their response to the first three statements implies. Conversely, it is of interest that McGill faculty do not feel limited by being a linguistic minority in a French speaking province, despite frequent claims to the contrary.

Attitudes regarding the professional benefit of competence in French markedly differentiate the staff of the two institutions. McGill faculty does not perceive French as a language of much professional value. Few engineers at McGill published in French. Only one respondent regularly read or received French language engineering journals. Most did not name a single colleague in their field at a French medium institution with whom they communicated professionally on a regular basis. It is hardly surprising, then, that proficiency in French is seen as of little

professional value. On the other hand, McGill engineers do not believe that Francophones operate under any professional handicap. "After all," many McGill faculty explained, "if a man is any good, he communicates in English."

Professors at Ecole Polytechnique generally accept the necessity of communicating in English to obtain recognition. They do not feel that it imposes a special disadvantage. Still, more resentment may be evident on the issue of recognition from Anglophone Canadians.

A series of questions in the interview schedule asked respondents to identify two engineering institutions in their field which they would rate higher and lower in terms of graduate training and research. The majority of faculty in both institutions rate American engineering institutions higher in graduate training and research, indicating a strong orientation toward the American engineering community irrespective of language. Among institutions ranked lower in these areas by McGill professors, the Ecole Polytechnique was often mentioned. Perhaps in recognition of their status in the eyes of Anglophone colleagues, many faculty (33%) at Ecole Polytechnique felt that their institution had a lower reputation than it deserved.

Institutional Satisfaction

It has been hypothesized that engineers at the Ecole Polytechnique would be less satisfied with their institutional environment, an extension of their dissatisfaction with professional opportunities in a French language milieu. The scale used to measure institutional satisfaction required faculty to evaluate several aspects of their work. These aspects encompassed measures of the physical environment and amenities--for example, work facilities and institutional location--as well as more subtle measures of

the conditions for academic work, such as relationships to peers and superiors, openness to new ideas, the chance to fulfill long-term career goals, among others. Respondents rated each aspect from "terrible" to "excellent" (on a scale from zero to four).

Mean scores for respondents at the two institutions vary significantly though the difference in absolute terms is small (41.6 versus 38.9). McGill engineers express more satisfaction with their institutional environment. The differences between the two groups were greatest in respect to salary, openness to new ideas, opportunity to publish, relevance of present job to interests and institutional location.

Table 4

Oneway Anova for Institutional
Satisfaction and Institutional
Priorities by Institutional Affiliation

	McGill N-56 Means	Ecole Polytechnique N-68 Means	Significance
Institutional Satisfaction (low score indicates dissatisfaction):			
salary	2.7	2.4	*
promotion	2.6	2.4	NS
facilities	2.5	2.3	NS
chance to use training	3.4	3.3	NS
openness to new ideas	3.0	2.5	*
respect for superiors	3.1	2.8	NS
acceptance from co-workers	3.0	3.0	NS
opportunity to gain professional recognition	3.1	3.0	NS
ability of students	2.1	2.1	NS
chance to fulfill career goals	2.9	2.8	NS
opportunity to publish	3.2	2.8	*
relevance of job to interests	3.4	3.1	*
location of institution in comparison to original hopes	2.8	2.4	*
	2.9	3.0	NS
Total	41.6	38.8	*

* p < .05
** p < .01
*** p < .001

The higher level of dissatisfaction with salaries on the part of Ecole Polytechnique professors is of considerable interest inasmuch as the salary structure of the two institutions is comparable and the composition of the groups is broadly similar in age and academic rank. English and French universities in Quebec, we have pointed out, developed autonomously. One important difference between the English and French sectors is the syndicalization of the academic profession in Francophone universities. An outcome of syndicalization may be a lesser inhibition to express concern with the remunerative aspects of academic life. The difference between the two institutions on the matter of salary may also reflect differences in the perception of academic life in Francophone and Anglophone communities. Engineers at Ecole Polytechnique for instance ranked the relative independence of professors significantly lower as a factor attracting them to academic work compared to their colleagues at McGill ($F=3.91$, $p < .05$). This is perhaps consistent with their acceptance of syndicalization.

Another aspect of institutional environment produced significant variations between the groups. Ecole Polytechnique respondents are more dissatisfied with opportunity to publish which should be viewed in light of their lower level of research activity. A dissatisfaction with research opportunities is apparent in answers to related questions. Professors at Ecole Polytechnique were more likely to cite unresponsiveness of their institutions to their needs as a handicap to research than those at McGill ($\chi^2=.43$, 1 d.f., $p < .05$). They were also more likely to feel that a professor's teaching commitments should be reduced in recognition of research activities ($\chi^2=4.50$, 1 d.f., $p < .05$).

Another way of examining the institutional environment is to study the institution's "reward system", more specifically, the criteria it uses to evaluate the professional performance of faculty. In order to ascertain the reward structure of the two engineering institutions and of faculty, we asked respondents what importance is and should be given to teaching, research, committee work, administration and consulting in decisions regarding promotion and tenure. The data obtained for this question is presented in Table 5.

Table 5

Oneway Anova for Institutional
Priorities by Institutional Affiliation

	McGill N-56 Means	Ecole Polytechnique N-68 Means	Significance
<u>Institutional Priorities</u>			
In decisions regarding tenure & promotion, what importance <u>is</u> given to (low score implies more importance):			
teaching?	1.9	1.8	NS
committee work?	2.0	2.3	**
administration?	1.9	2.4	***
consulting?	2.9	2.4	**
research?	1.3	1.4	NS
In decisions regarding tenure & promotion, what importance <u>should</u> be given to:			
teaching?	1.2	1.2	NS
committee work?	2.3	2.7	**
administration?	2.3	2.9	***
consulting?	2.8	2.3	***
research?	1.3	1.4	NS
* p < .05			
** p < .01			
*** p < .001			

At McGill and the Ecole Polytechnique, research and teaching are viewed as the two most important activities in promotion and tenure, with research, somewhat unexpectedly in the case of Ecole Polytechnique, being given a slightly higher priority. At both institutions, respondents suggest that teaching is assigned less importance than it should be. But there are significant differences in terms of importance of other activities. Compared to their counterparts at Ecole Polytechnique, engineering professors at McGill say that more importance is and should be given to administration and committee work in tenure and promotion. Academic management seems to be valued highly as a professional activity at McGill whereas at Ecole Polytechnique it is perhaps seen more as "interference" with professional work, possibly an indication that in the Francophone milieu, academic work and academic management are dichotomous rather than complimentary.

A higher priority is accorded at the Ecole Polytechnique to consulting activities. This may be an outcome of the more recent attention given in that institution to graduate training and research and the larger number of staff with master's degrees. At McGill, which has a longer tradition of graduate training and research, consulting work is often viewed as "time taken away from teaching and research".

Summary and Implications

To review the findings of the previous sections, it has been shown that faculty affiliated with Ecole Polytechnique exhibit a lower level of research productivity than their colleagues at McGill. However, the lower level of scholarly productivity at the Ecole Polytechnique, is largely a function of differences between the two institutions with

respect to the respondents highest degree. Insofar as attitudes toward professional role of French are concerned, there is little evidence to support the contention that a French language environment imposes a special handicap. Finally, in comparing the institutional satisfaction and perceptions of institutional priorities of respondents, we have noted that, while McGill faculty were more satisfied and gave more importance to the managerial aspects of academic life, professors at Ecole Polytechnique can not be characterized as highly dissatisfied and they share similar attitudes toward teaching and research. In sum, the hypothesis that discrepancy between language of work and language of professional communication and recognition is productive of isolation, demoralization and inactivity must be rejected.

An important finding of this study is the lack of communication between the two engineering institutions. To characterize the relationship between French and English engineering communities, it would be appropriate to use the expression mentioned in the beginning of this paper: two solitudes. Founded in solitude a hundred years ago, the two engineering communities have evolved along similar lines, each keeping its solitude vis-à-vis the other.

The autonomy of French and English engineering communities is more remarkable in light of the pervasive similarities in professional attitudes and activities, transcending cultural differences between the French and English speaking populations in Quebec. Although French is the language of instruction and of every day work at the Ecole Polytechnique, the central finding of our research is that the networks of communication and recognition linking this institution with engineering communities in

other countries operate primarily in English. Provincial and Federal science policies encouraging the use of French in scientific communication and recognition seemed to have had little impact. For both French and English speaking engineering professors, the American 'connection' seems to be the dominant orientation. They may be reflective of the common professional socialization of the two groups, in particular the preponderance of American trained engineers at the two institutions.

It has been mentioned earlier that language is a salient feature in the science policies not only of Quebec but of many other societies. Language is regarded as a means to foster self-sufficient scientific infrastructures.

Our findings indicate that linguistic policies are of little effectiveness in shaping patterns of scientific communication and recognition. The case of Quebec, of course, may not be generalizable to other settings. For one thing, the geographical, educational, economic and scientific proximity and influence of the United States on Canadian society is certainly unique. Still, the Quebec experience may have lessons for other countries insofar as the limitations of language as an instrument of science policy are concerned.

This study has been carried out in the context of the question: to what extent is science defined by political, social and economic factors as well as factors intrinsic to the nature of scientific work? Engineering, we have noted, is felt to be a more locally defined area of inquiry compared to the more cosmopolitan sciences. There is little support for such characterizations, in our study, however. Engineering professors at McGill and at Ecole Polytechnique were found to be in close contact with their colleagues in other engineering communities abroad. They appear to exhibit the same cosmopolitan orientations of scientists.

Unfortunately, we have not as yet collected comparable data for academics in the sciences and therefore are unable to substantiate this observation. Nevertheless, our findings cast doubt on the alleged more parochial orientation of engineers.

NOTES

1. Although no specific attention has so far been paid to the language issue as an element of science policies of developing countries, one finds references to it dispersed over the entire literature on science and development. Among countries where a local language was promoted as a science lingua franca one could name India, France, 19th century and post-revolutionary Russia, as well as most of the constituent republics of the USSR such as the Ukraine, Armenia or Lithuania.
2. See, e.g. : Ouellet, C., La vie des sciences au Canada français, Québec : Ministère des affaires culturelles, 1964 ; Abbott, M.E., History of Medicine in the Province of Quebec, Montréal : McGill University, 1931, Tory, H.M., A History of Science in Canada, Toronto : Ryerson Press, 1939.
3. Blume, S., Chartier, M.J., The Effects of Biculturalism on Science in Canada, Montréal : Institut d'histoire et de sociopolitique des sciences, 1974, a mimeographed paper.
4. A Science Policy for Canada, Ottawa : Information Canada, 1971-73, 3 vols. See also : Doern, B., Science and Politics in Canada, Montréal : McGill-Queens University Press, 1972 and Reviews of National Science Policy : Canada, Paris : OECD, 1969.
5. See, e.g. : De Solla Price, D.J., The Difference Between Science and Technology, Detroit : T.A. Edison Foundation, 1968.