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ABSTRACT

The relationships among the types of subject matter studied in secondary school classes and the nature of interpersonal relationships in these classes and the pupils' perceptions of their class experiences is examined. To explore possible interactions between teacher characteristics and subject taught the sex of the teacher was included in the analysis. Data were obtained from science, math, humanities and foreign language classes in eight English speaking Montreal secondary schools. The Learning Environment Inventory was used to ascertain the students' perceptions of the classroom climate along fifteen dimensions that reflected the pupils' relationship to one another, to the organizational properties of the class, to the physical environment and the class activities. The findings imply that the students' perceptions of the classroom climate differed according to the nature of the subject but that sex of the teacher was unrelated to these perceptions. (RSM)

EFFECTS OF TEACHER SEX AND COURSE SUBJECT MATTER ON THE SOCIAL CLIMATE OF LEARNING[1]

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Educators often claim that the quality of an educational experience is less closely related to the material learned than to the nature of the process of learning. Indeed, the progressive educators of the 1930's (Dewey, 1938) valued experience almost to the exclusion of content. While present opinion is perhaps less categorical, recent thinkers (Bruner, 1960; Schwab, 1962) have stressed a student-centered discovery method of learning as an ideal. Yet despite these pleas for enquiry in all school learning, certain areas of the school curriculum seem more easily adapted to such a method than do others. The sciences, in particular, with their emphasis on laboratory experience, have enjoyed a wealth of experientially-oriented course development projects (BSCS biology; Harvard Project Physics, etc.) in recent years. The purpose of this study is to assess and examine the relationships among the types of subject matter studied in secondary school classes and the nature of interpersonal relationships in these classes, as well

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as pupils' perceptions of their class experiences. To explore possible interactions between teacher characteristics and subject taught, the sex of the teacher was included in the analysis.

Prior research on the relationship of teacher sex to classroom behavior is extensive and will be reviewed here only briefly. Ryans (1960) Teacher Characteristics Study yielded some broad but perhaps useful generalizations. Observational data suggested that in contrast to men, women teachers at the secondary level scored higher on scales which characterized classroom behavior as understanding and friendly, responsible and businesslike, and also stimulating and imaginative. Questionnaire data suggested that women teachers had more favourable attitudes pupils, democratic classroom practices, permissive educational viewpoints and verbal understanding. Within subject areas, mathematics and science teacher sex differences resembled the characteristics generally found among secondary teachers as described above. Within the English-Social Studies group, women were higher on measures of responsible, systematic classroom behavior only.

Flanders (1964) data on classroom interaction also suggests subject matter differences. While this was not the purpose of Flanders' study, his data (Table 2, p. 219) shows that in all cases the six so-called "indirect" mathematics teachers had higher i/d (indirect/direct) ratios than did six "indirect" teachers of social studies. For "direct" teachers, the differences were much less pronounced and are probably not statistically significant. Reasons for the differences are not altogether clear. It could be that the nature of classroom activities in the two subjects differed in such a way as to produce these results.

A more recent study (Anderson, Walberg & Welch, 1969) demonstrated differences within a single subject area when a new flexible experiential type physics course was contrasted to more traditional courses. The new course was viewed as less difficult, less goal directed and containing a greater diversity of experiences.

Yamamoto et al (1969) studied pupil perceptions of various aspects of the school including the curriculum. Semantic differential ratings of four courses by junior high school pupils led to two factors, termed <u>vigor</u> and <u>certainty</u>. Mathematics and science courses had equal and high scores on vigor while social studies and languages were rated significantly lower. The <u>certainty</u> concept which incorporated such adjective pairs as "safe-frightening" and "easy-difficult" was highest for languages with mathematics, social studies, and science, respectively rated less certain.

The prior research suggested a number of general trends which led to several broad hypotheses for the present investigation. It was expected that classes in the more activity prone school subjects, specifically science, and to some extent, mathematics and languages, would be viewed as more disorganized with more interpersonal friction among classmates, cliqueness, and a greater diversity of learning experiences. Science and mathematics classes were expected to be perceived as more difficult than classes in the humanities. The precise effects of teacher sex on the classroom climate were difficult to anticipate. Hence, no main effect for teacher sex was hypothesized. However, it was expected that teachers in sex-incompatible subject areas (particularly female teachers in science) would have classes perceived with extremes on such properties as cliqueness, disorganization, friction and difficulty.

METHOD

Sample

Data were obtained during a one-month period in mid-winter, 1970, from eight English-speaking secondary schools in the Montreal Metropolitan area. The sample was stratified to represent four reasonably distinct geographic regions, and two schools were chosen from each region. Classes were sampled randomly within schools, and represent four major subject matter groups as shown in Table 1.

- Insert Table 1 Here -

The science group includes six classes of physics, 10 of biology and 10 in chemistry. Mathematics classes were split about evenly between algebra and geometry. The humanities classes include eight in English literature and eleven in history. One of the language classes (male teacher) is Spanish while the rest are French.

Pupils generally ranged from 15 to 17 years of age and had mean scores[2] on the Henmon-Nelson Test of Mental Abilities corresponding to the 43rd percentile of college-level students (males = 45th percentile; females = 40th percentile).

Instrument

The 15 scales of the Learning Environment Inventory describe the classroom climate as perceived by the pupils along 15 dimensions that reflect the relationship of the pupils to one another, to the organizational properties of the class, to class activities, and to the physical environment. The instrument is a slight modification of an earlier one of the same name (Anderson, 1970). In all, six of the original items were modified and a competitiveness scale was added. Each of the Learning Environment Inventory scales contains seven statements descriptive of typical high school classes (see Table 2).

The respondent expresses the extent of his agreement or disagreement with each item on a four-point scale. For each of the 15 dimensions, the mean response on the seven items is calculated and the mean of all student ratings in each class provides the estimate of the collective student perception of their classroom climate.

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[2]Based on a random sample of 103 pupils.

Statistical Analysis

A 2 (teacher sex) x 4 (course) multivariate analysis of variance (Jones, 1966; Bock, 1966) with the 15 Learning Environment Inventory scales as dependent variables was used to examine the effects of teacher sex, course subject matter, and their interaction on the social climate of learning.[3]

A multivariate analysis is useful in problems such as this one as it enables not only tests for the contribution of each effect to each dependent variable, separately, but also the examination of overall concomitant effects on all variables considered simultaneously (see Jones, 1966 for a more complete discussion of the advantages of multivariate analysis of variance). Indeed, a multivariate test is essential in order to avoid the fallacy of obtaining statistical significance through repeated application of a univariate test to correlated variables.

Teacher sex was entered first in the design in order to provide the most conservative test possible for the course effect. By entering sex first, the variance related to teacher sex is removed from the 15 dependent variables prior to examining the relationship of course to learning environment variance. That is, teacher sex is partialled out before the test for course effects is performed.

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[3] I wish to thank Arthur I. Rothman of the Medical Education Research Unit, University of Toronto, for his IBM-360 adaptation of the "Multivariance" program.

The multivariate analysis first performs an F-test for equality of mean vectors. This is used to determine the probability of obtaining observed differences across all variables by chance alone. If the overall test implies that overall differences do exist, then these differences may be examined further in several ways. The individual contribution of each dependent variable to discrimination among levels of an effect may be tested as in a traditional analysis of variance with only one dependent variable. However, this method has the disadvantage of not incorporating concomitant effects among the battery of dependent variables. Another approach is to fit discriminant functions to the dependent variables in order to more adequately characterize differences among the levels of the factor. This approach fully utilizes the available data and provides for interactions among dependent variables. Sometimes with such a method levels are found to differ in more than one significant way. In such cases several discriminant functions may be fitted and tested for significance (the maximum number of such functions equals the d.f. for the hypothesis). The amount of variance associated with each function is also calculable. Differences among the levels on each factor can be explored by plotting each of the cell means in a discriminant space (see Anderson, Walberg & Welch, 1969).

RESULTS

The overall results of the significance tests for each effect are summarized in Table 3. The main effect for teacher sex was not statistically significant, nor was the teacher sex x course interaction. However, the course effect did relate significantly to the 15 learning environment dimensions. Furthermore, three significant independent types of learning environment differences associated with the course effect were uncovered. The first dimension of course differences accounted for 47% of the learning environment variance, while the second and third discriminant functions accounted for 36% and 17%, respectively.

F-tests for each of the 15 scales are listed in Table 4 as are the standardized discriminant function coefficients which define each of the three discriminant functions. High values on the first function (D_1) are associated with classes perceived as highly Formal (.49), but Apathetic (.73) and containing low scores on Friction (-1.18), Difficulty (-.64), Disorganization (-.48), and Favouritism (-.42). The second function, D_2, is such that high scores on the scales Diversity (.82), Cohesiveness (.78), Goal Direction (.74) and Apathy (.74) and low scores on Satisfaction (-1.08), Disorganization (-.79), Formality (-.60), and Speed (-.54) define high values on D_2. High values on D_3 are characterized by classes scoring high on Satisfaction (1.45), and Disorganization (.58) with low scores on Goal Direction (-1.26) and Apathy (-.41).

The course effects are shown in Figure 1, the plot of the eight cell means in the discriminant space formed by D_1 and D_2.

In terms of courses, D_1 seems primarily to differentiate between mathematics classes and the others. Mathematics classes are perceived as containing more friction among pupils, and disorganization, but are viewed as informal, even apathetic, as compared to classes in science, humanities, and languages. Mathematics is also viewed as difficult by the pupils. The second discriminant function, D_2, clearly separates the humanities from the sciences. Classes studying the humanities in contrast to those studying science are characterized by high scores on Diversity, Cohesiveness, Goal Direction, and Apathy with correspondingly low scores on Formality, Speed, Satisfaction, and Disorganization. D_3 is not shown in the figure, and serves only to separate the female-language group (high score on D_3) from the male-language classes (low score on D_3).

DISCUSSION

The results imply that teacher sex is unrelated to pupils' perceptions of the learning climate within their classes. Whether this result will withstand the test of additional data can only be speculated here. Other studies (Walberg, 1968) have shown teacher personality to relate to classroom climate, and as personality is related to sex, further studies may well show some relationship between teacher sex and classroom climate. A more in-depth study should independently account for boys and girls perceptions of climate. The use of class means in this analysis may have masked any differential effects by student sex.

The course differences, while clear in some instances are confusing in others. The cell means within each subject area for each teacher sex should ideally be just about equal after the sex effect has been statistically removed. This is the case for most groups, but does not hold for language classes taught by male and female teachers. Presumably, the small sample of female language teachers (n=2) is a major contributor to such a result. We might consider the male teacher group most representative, in which case language classes resemble those in the humanities. However, further study will be required before the nature of the classroom climate of language classes can be adequately characterized.

The results for mathematics classes perhaps relates to the nature of mathematics teaching which incorporates much small group and seat work. Pupils are expected to assist one another and perhaps argue over correct procedures to follow. Further support for such an interpretation is in Flanders' (1964) study cited earlier which characterized mathematics teaching as highly indirect. Whether the resulting friction, lack of formality, and perceived disorganization within mathematics classes leads to creativity and independent learning cannot be determined here. It is interesting to speculate, however, that this type of learning environment may relate to the lower achievement scores reported by the recent International Study of Mathematics by American children as contrasted to the Japanese.

Science and humanities classes differed on the second dimension of discrimination, with the science group perceived as formal, fast-paced and disorganized with little cohesiveness, diversity or goal direction. Science classes were considered more satisfying and less apathetic than were classes in English and history. Some of these dimensions seem contradictory and the discriminant loadings, no doubt, result from suppressor-effects within the climate battery. It could be that the implicit disorganization resulting from the nature of science as studied in our schools provokes teachers to impose more formal procedures and rules of operation than would be necessary in humanities classes. The apparent satisfaction in the sciences may relate to the interesting, discovery-oriented subject being studied; whereas, the humanities lead to apathy towards the subject and pupils derive their experience more out of the class group itself -- its properties of informality, diversity, slow-speed and cohesiveness.

The teacher sex-subject matter interaction was not statistically significant, though it should be pointed out that the sample included no female physics teachers. Such teachers would need to be included in order to fully test the hypotheses relating to teacher sex and subject matter incompatibility. For the present, there is no subject area in which male and female teachers have significantly different effects on classroom climate.

In terms of the general hypotheses, as predicted, mathematics and science classes tended to be viewed as disorganized.

Also, mathematics classes were found to contain interpersonal friction and difficulty, but the hypotheses involving more cliqueness and diversity were not supported.

In summary, the findings imply that classes differ according to the nature of the subject being studied. While some educational philosophers might argue for more of one type of learning environment than another, others would probably prefer a balance as represented by the present school curriculum. In any case, it would appear that this line of investigation should be pursued. With adequate controls it should then be possible, not only to measure the precise knowledge that pupils learn, but also to describe their educational experiences in terms of the learning environments accounting for that knowledge.

TABLE 1

Description of the Sample

	Teacher Sex		
	male	female	Total
Subject Area			
Science	20	6	26
Mathematics	3	6	9
Humanities	13	6	19
Languages	6	2	8
Total	42	20	62

TABLE 2

Learning Environment Inventory Scales

Scales			Alpha[a] Reliabilities
1.	Cohesiveness	Members of the class are personal friends.	.69
2.	Diversity	The class divides its efforts among several purposes.	.53
3.	Formality	Students are asked to follow a complicated set of rules.	.76
4.	Speed	The class has difficulty keeping up with its assigned work.	.70
5.	Environment	The books and equipment students need or want are easily available to them in the classroom.	.56
6.	Friction	Certain students are considered uncooperative.	.72
7.	Goal Direction	The objectives of the class are specific.	.85
8.	Favoritism	Only the good students are given special projects.	.78
9.	Difficulty	Students are constantly challenged.	.64
10.	Apathy	Members of the class don't care what the class does.	.82

[a]Based on a sample of 1048 individuals. Sample intraclass correlations for the reliability of class means are shown in Anderson (1970).

TABLE 2

Learning Environment Inventory Scales (Cont'd)

Scales			Alpha [a] Reliabilities
11.	Democratic	Class decisions tend to be made by all the students.	.67
12.	Cliqueness	Certain students work only with their close friends.	.65
13.	Satisfaction	Students are well-satisfied with the work of the class.	.79
14.	Disorganization	The class is disorganized.	.82
15.	Competitiveness	Students compete to see who can do the best work.	.63

[a]Based on a sample of 1048 individuals. Sample intraclass correlations for the reliability of class means are shown in Anderson (1970).

TABLE 3

Overall Tests of Statistical Significance for Teacher Sex, Course, and the Interaction

Teacher Sex

dfh	1	(df for hypothesis)
dfe	54	(df for error)
Multivariate F	1.35	
df	15/40	
prob.	> .20	

Course

dfh	3
dfe	54
Multivariate F	3.06
df	45/120
prob.	< .001

Tests for Discriminant Functions

	D_1	D_2	D_3
% of canonical variance	47.1	35.6	17.3
Bartlett's Chi Square	108.0	61.4	22.7
df	45	28	13
prob.	< .001	< .001	< .05

Teacher Sex x Course Interaction

dfh	3
dfe	54
Multivariate F	1.22
df	45/120
prob.	> .20

TABLE 4

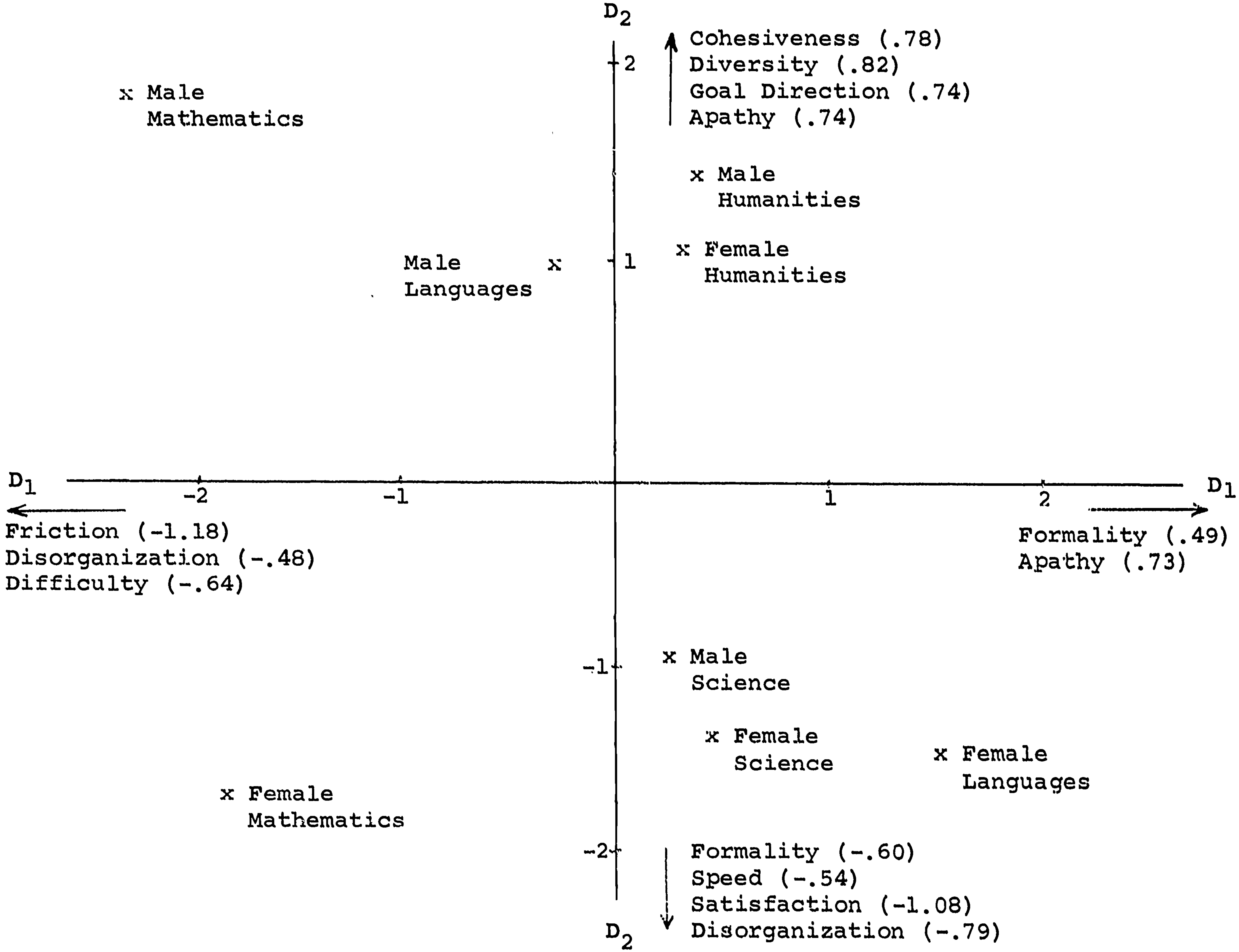
F-Tests and Discriminant Functions for the Course Effect

Scale	F-Test for Scales	Standardized Discriminant Function Coefficients D_1	D_2	D_3
Cohesiveness	2.6	-.23	.78	-.20
Diversity	2.1	.17	.82	.01
Formality	7.7**	.49	-.60	.13
Speed	3.6*	.12	-.54	.23
Environment	2.2	-.05	-.36	-.23
Friction	3.2*	-1.18	.00	.08
Goal Direction	4.3**	-.33	.74	-1.26
Favouritism	2.3	-.42	.37	-.27
Difficulty	7.6**	-.63	-.35	-.24
Apathy	0.1	.73	.74	-.41
Democratic	1.2	-.35	.06	-.27
Cliqueness	3.7*	-.11	-.32	-.11
Satisfaction	1.3	-.09	-1.08	1.45
Disorganization	5.9**	-.48	-.79	.58
Competitiveness	0.8	.24	-.04	.37

* $p < .05$
** $p < .01$

FIGURE 1

Plots of Cell Means in Discriminant Space



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