GENDER TRACKING IN UNIVERSITY PROGRAMS:

An Analysis of Gender Patterns in

Canada Scholarships Program (CSP) Disciplines and

Non-CSP University Disciplines

Final Report

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EXECUTIVE SUMMARY

Context of the Study

Differences in the first to second year renewal rates between male and female Canada Scholars raise important questions about the recruitment and retention of talented women in natural science and engineering disciplines.

Objectives

The major purposes of the research are: (a) to identify why women students choose arts, humanities and applied science disciplines to a greater extent than natural science, engineering and related disciplines, and (b) to investigate the relationship between psychological/ motivational factors and academic achievement in the retention of women within natural science and engineering disciplines, and (c) to indicate the policy implications of the results for the Canada Scholarships Program.

Research Design

The research combines secondary data from an on-going, major, longitudinal study of student progress and student attrition with new quantitative and in-depth data which were gathered specifically to measure the factors associated with the recruitment and retention of women in university CSP disciplines.

Major Conclusions

There are fundamental gender patterns in values, encouragements, and perceptions of self and science which affect recruitment into science disciplines, experience and academic performance in these disciplines and, ultimately, decisions to persist or to depart.

Women in science and non-science programs exhibit, to a greater extent than men, a response and care value orientation which emphasizes personal relationships, maintaining connections with others, caring for self and others, and working in supportive environments.

Women entering science, particularly the high achievers, indicate that encouragement from teachers, good grades in high school, the expectation of good grades in university and a desire to be self-sufficient were important influences in their choice of discipline.

Although both men and women are recruited to science programs, they respond to different calls. Many women enter science expecting to be able to experience science instruction within a response and care value orientation. For example, women students in the highest achievement category value working in a supportive environment

and having harmony in their work/study environment much more so than comparable men in science.

There is a marked tendency for academic performance to decline between high school and the first few semesters at university, especially for women in science. However, the gender difference in academic performance lessens in the last few semesters at university.

The overall program retention rates for women and men in science are very similar but this does not tell the whole story. First, entering grades have a stronger influence upon program retention for women in science than for men. Second, women students entering university with an 'A' high school average tend to transfer to non-CSP disciplines. Third, the departure of women high achievers from science disciplines is related not only to their academic performance in university but also to their values, expectations concerning science education, and their career plans.

Many high achieving women experience difficulty in dealing with the non-cognitive, social and value orientations of science programs. A concern here is that intellectually competent women, more so than their male counterparts, may be leaving science partly in response to pressures created by a lack of fit between their value orientations and expectations and the practices, realities and values of the educational environment. It is also possible that this lack of fit produces a decline in the academic performance of women early in their university careers.

There is no doubt that women prefer warm, supportive and caring work/ study environments where there is an opportunity to help others. Science is not normally perceived in this way. It appears that science instruction in particular is not perceived in this way. Yet there is a collective, collaborative and affective component in the way science is practised. There is a need for improvement in science teaching and curriculum.

It appears that many women take science programs, not because they wish to pursue a career in the field, but to obtain a prerequisite for a career in another field. It may be the case that rather than a life-long goal or ambition, science is regarded as a means to an end. The career destinations appear to be more practical, applied, and more oriented to helping, curing, and healing.

There are much more than financial matters involved in gender tracking. If women entering science disciplines knew what to expect, knew how to manage the transition to university, and had more support in their first year, more positive outcomes would occur. Similarly, if the educational climates within natural science and engineering fields were more hospitable many more talented women would remain in these disciplines.

Policy Implications

The following recommendations are intended to enhance recruitment into natural science and engineering programs, particularly for talented women students:

1. Public awareness efforts to improve the image of science as practiced. Information about science and science programs should be directed especially to high school teachers, parents, and secondary school students. The information should be realistic, focussing upon the opportunities, challenges and the difficulties of pursuing a career in science. Where possible, legitimate connections between response and care values and actual science practice should be emphasized.

2. Women Scholars should be provided with an honorarium to talk about their experiences and plans with interested high school students. This mentoring might be co-ordinated through the existing Speakers' Bureau Pilot Project and the Canada Scholars Register.

The following recommendations are intended to enhance program retention for women scholars:

1. Social support initiatives to assist scholars with the important transition from first to second year should be developed.

2. The Mentor Clubs represent one example of the kind of social support necessary and consideration should be given to expanding this initiative so that a Club exists at each university.

3. Funds should be allocated to establish a position whereby a program officer would visit university campuses and meet with groups of scholars to discuss experiences, progress and difficulties. Where warranted individual consultations might occur.

4. A CSP newsletter should be established to keep scholars informed of current issues, including gender issues, and containing a list of persons to contact on campus should problems arise. Mentor Club participants would be likely candidates. Commissioned articles, research abstracts, and letters could share the vicissitudes of majoring in natural science and engineering fields.

5. Scholars, and possibly all women entering science disciplines, should be provided with materials informing them of some of the possible difficulties they may encounter and offering suggestions for dealing with them. This information should be based upon the experiences of students as they complete their programs.

6. Institutions accepting Canada Scholars should be asked to conduct non-renewal interviews with women scholars. Such interviews would be voluntary and could provide important information on why scholars experience difficulty in maintaining their level of academic achievement.

7. **A modest, pilot fund for the enhancement of science teaching should be established. New approaches toward classroom and laboratory instruction which emphasize personal, relevant, practical, hands-on, co-operative and creative settings and experiences, would have positive consequences. Projects should be evaluated and science instructors should be made aware of successful and unsuccessful initiatives.**

8. **More research should be conducted on the relationship between the characteristics of the teaching environment in science and students experiences and achievements.**

9. **Consideration be given to developing less stringent renewal criteria.**

1. INTRODUCTION

The ***Canada Scholarships Program*** (***CSP***) was established in 1988 as part of a major package of new science and technology initiatives which seek to enhance Canada's international competitiveness by producing more scientific and technologically literate individuals. In the emerging knowledge and information-based economic world order investment in human resources is expected to lead to a high standard of living and a healthy quality of life. Highly qualified individuals are considered to be the cornerstones of industrial innovation and economic growth.

Two of the fundamental purposes of the ***Canada Scholarships Program*** are, first, to increase the enrollment of top students in undergraduate natural science and engineering disciplines and, second, given the significant underrepresentation of women students in natural science and engineering programs, to encourage more outstanding women students to pursue educational programs and careers in these areas.

Scholarships of $ 2,000 per year, which are renewable for up to four years of study for a total value of $ 8,000, are awarded to full-time students in first-year undergraduate natural science and engineering degree programs. The Canada Scholarships are awarded and renewed on the basis of top academic performance, that is, first-class academic standing in eligible disciplines. At least one half of the scholarships are awarded to women.

The ***Canada Scholarships Program*** has been successful but there is some concern over first year to second year renewal rates, especially for women scholars. For the 1988 Canada Scholars, 65% of males and 46% of females renewed their scholarships into the second year. This pattern is repeated for the 1989 Scholars. The large majority of non-

renewals (88%) occur because Scholars have not attained first-class standing in their initial year of undergraduate studies.

The major purpose of this research report is to provide findings which can be used by CSP managers and policy makers in the achievement of CSP goals concerning the recruitment and retention of high achieving female students. The report examines the role of preference, motivation and achievement in gender tracking in undergraduate university programs, particularly natural science and engineering disciplines.

The concentration of women and men in specific occupations and education programs is a well-established finding. For example,Canadian undergraduate enrollment data for 1987-88 indicate that women comprise only 13% of full-time undergraduates in engineering and applied sciences and only 27% of full-time undergraduates in mathematics and the physical sciences. On the other hand, women represent approximately 65% of the enrollment in education and health science programs (AUCC, 1990).

Less well-established are the mechanisms and processes by which gender tracking occurs. The gender tracking research reported here employs a unique four year longitudinal database which is augmented by questions designed specifically to examine discipline choices of undergraduate women students and the achievement of women in ***CSP*** disciplines. The quantitative survey research data is further enhanced by qualitative in-depth interviews with high achieving women, including both those who have departed from, as well as those who have remained in, eligible ***CSP*** disciplines.

The analysis proceeds by first examining recruitment, or the relationship between gender and discipline choice between the natural sciences and engineering disciplines and other disciplines. The report examines the attitudes, values and experiences which lead to gender tracking in university programs. The psychological/motivational factors underlying these discipline choices are investigated by comparing influences across and within educational programs. Information is provided on the factors which underlie choices by women who enrol in science-related disciplines and women who enrol in the traditionally

selected disciplines. Similarly, psychological and motivational differences between males and females in the natural science and engineering disciplines are investigated. The analysis seeks to provide information on why female students choose certain types of educational programs and not others, and on how they differ from male students within those programs.

A second focus of the analysis is upon the relationship between gender and achievement within natural science and engineering fields. The analysis explores the consequences of gender tracking for student outcomes and achievement. Specifically, if there are significant differences between the women and men who enter mathematics, science and engineering programs at university, how might these gender differences impact upon their persistence, completion and success within those programs? Similarly, are there differential experiences for women and men at university which may alter their choice of educational destination? The gender and achievement analysis examines factors such as marks and other academic outcomes, academic pursuits, contact and satisfaction with faculty, and educational and career aspirations. The gender and achievement analysis looks at 'A' and 'B+' students separately.

This *Final Report* (1) contains the results of the June 27, 1990 *Interim Report*, (2) presents further findings on the university experiences of women and men, (3) on institutional leavers, program changers and program persisters or stayers, (4) incorporates qualitative information from in-depth interviews conducted with program leavers and program persisters and (5) draws out the implications and limitations of the research for the ***Canada Scholarships Program***. The *Report* attempts to provide information on the difficulties associated with the recruitment and retention of women in science, engineering and related disciplines.

2. PREVIOUS RESEARCH

At one time it was common to locate the source of women's underparticipation in mathematics and science programs within females themselves. It was claimed that women lacked certain fundamental traits that would enable them to engage in scientific activity. In particular, women were characterized as possessing little spatial and mathematical ability, in part for genetic reasons (Maccoby and Jacklin, 1974). These deficiencies led to poor performance, and thus to low participation. These explanations are strongly contested within the scientific literature on the topic (Ethington & Wolfe, 1984; Fausto-Sterling, 1985).

A more recent sophisticated version of this 'trait' approach involves ascertaining whether women are lacking in some other mathematics or science-related psychological traits, but ones that are subject to environmental intervention. The most recent candidate is autonomous learning behaviour (Fennema & Peterson, 1985).

Both the genetic and environmental versions of the 'trait' approach start with the knowledge that males participate more than women in mathematics and science programs. The next step is to search for traits on which men differ from women and that seem logically related to the ability to do mathematics and science. The third step is to attribute women's relatively low participation to the absence of the traits within them. Finally, a policy inference is made whereby women are to be provided with the experiences which would allow them to acquire, in an effective way, the traits which presumably enable men to be good at mathematics and science.

An alternate, and increasingly acceptable, approach sets aside assumptions about possible inherent mathematical and scientific-related abilities of women and men. Instead, the stress is upon the social determinants of participation in mathematics and science programs. The value of this approach is buttressed by a number of recent research results concerning:

(a) the timing of sex differences in mathematics achievement; (b) the diminishing differences over time; and, (c) variation of sex difference patterns in cross cultural settings. For example, in terms of achievement, when the number of courses taken is controlled for, women's teacher assigned grades in mathematics either equal or slightly surpass those of their male counterparts. Traits such as spatial ability correlate weakly with mathematics performance. Also, the gender differences in spatial ability are weak, and in some cultures, non-existent. In any event, differences on such mathematics and science related traits are easily narrowed or eliminated through training. Studies of attainment document that women's participation rates in science vary historically, at different times in the educational life cycle of any given cohort, and across as well as within disciplines. Women (relative to men) participate more now than in the past, more while in high school than in university, more at the undergraduate than the graduate level, and more in biology than in physics. What accounts for such pervasive variation?

A general concept used to examine the social context of science, and training for science, is patriarchy. This takes a number of forms. One form involves the claim that men may possess prejudicial attitudes of varying degrees of consciousness about women (e.g., negative stereotypes, biases) which result in discriminatory practices in the area of classroom interaction, hiring, and promotion (Dagg & Thompson, 1988).

More generally, it is also suggested that the double burden women carry in family as well as occupational life makes advanced scientific training impractical for them, especially given the demanding nature of scientific careers. A problem concerning this point is that in certain areas of study, such as psychology and education, over half the doctoral candidates are women. In addition, even within the sciences, the percentage of masters and doctoral candidates who are female varies by discipline.

A third aspect of the patriarchal theme has to do with the content of scientific work and how the image of scientific content is transformed into training or educational programs. The general concern here is that science is more than a cognitive process. It is a way of life

embodying a set of values and perspectives. In particular, its practices are closely tied to ideas of self and relationships, and hence to people's moral and ethical senses (Harding, 1986; Lengermann & Niebrugge-Brantley, 1990). Science is characterized as stressing the autonomy of the self and emphasizes limited and clearly defined reciprocal relationships with others. This has been termed a ***justice and rights orientation.*** The key image here is the lone laboratory scientist using the most advanced techniques and procedures in the relentless pursuit of 'truth' regardless of the consequences to self, family, friends, neighbours, or society. Less dramatically, the focus on the self-sufficient, competent scientific reasoner engaged in the disinterested pursuit of knowledge has elements that many find personally and socially unappealing and even disturbing. Disagreements exist about the extent to which science as it is actually practiced corresponds to the above image. But concern here is with science as it is taught, not as it is practiced. It is conceivable that the ***justice and rights orientation*** receives stronger expression in science courses than in science occupations.

Many people, including those with the cognitive capacity to do science, prefer a ***response and care orientation*** to self and others, an orientation that stresses one's ongoing involvement with others simply as a result of co-existence and values the ability to establish, develop, and maintain relationships in response to situationally specific exigencies.

Both moral orientations have cognitive correlates. That is, each fosters a distinctive way of thinking or reasoning about one's self and environment. Both men and women are able to comprehend and think in ways that are consistent with each orientation. But men more than women prefer the ***rights and justice orientation***, while women prefer the ***response and care orientation*** (Gilligan, 1982). For this reason, many people find the educational and occupational worlds of science unsatisfying as a means of expressing their emotional and ethical preferences. Given a choice, even cognitively competent women (and men) favouring a ***response and care orientation*** will choose to avoid science and instead seek environments that are more compatible with their basic value orientations.

Obviously, the above sketch of the two orientations obscures many of the complexities and ambiguities that characterize everyday life. Different science and mathematics disciplines, both basic and applied, manifest different combinations of, and tolerances for, the two orientations. This applies to the 'taught' as well as the 'professionally practiced' versions of each science. 'Science' is a single term referencing a plurality of activities.

It is unlikely that one or another of the perspectives reviewed above represents an unequivocally superior explanation over the others. Rather, it is likely that there are many dimensions to the issue of 'women in science' and, consequently, many contributory variables of varying magnitudes of importance. The issue of gender tracking and gender differences in mathematics, science and engineering programs is a complex matter.

Existing research indicates that women can do mathematics and science but that they avoid it by choice. This *Report* investigates the factors underlying the program choices women make and their subsequent experiences in ***CSP*** disciplines, including a special focus on women's' preferences for certain educational climates or ambiances. The *Report* explores also the relationships between such factors and retention.

3. METHODOLOGY

The gender tracking research reported here combines secondary data from an on-going, major, longitudinal study of student progress and student attrition with new data specifically designed to measure factors associated with the recruitment and retention of women in university ***CSP*** disciplines. The ***CEASE*** Project (***Career and Education Achievement in the Student Environment***) was funded by the *Social Sciences and Humanities Research Council of Canada*, the *Secretary of State for Canada*, and the *University of Guelph.* The research project was conceived initially to test the Vincent Tinto (1987) model of attrition from university with a tighter research design and better data than existing American studies. The project featured a longitudinal design rather than a cross sectional approach and, consequently, captured current measures of the variables as opposed to retrospective measures. The project also contained a more precise operationalization of the original dependent variable, student departure, by differentiating among transfers, those required to withdraw, stop-outs, and system leavers.

In the fall of 1986, all new first semester students at the University of Guelph were surveyed, via a questionnaire, on their background characteristics and their aspirations and expectations regarding university life (*Questionnaire 1*, Fall 1986, N=1937). These same students were contacted again after two semesters and data were obtained concerning actual university experiences, problems, learning and knowledge acquisition along with various student satisfaction measures (*Questionnaire 2*, Winter 1987, N=1626).

In the Fall 1987 semester, the same cohort of students was again contacted for an even more detailed evaluation of how well studies were progressing in terms of knowledge and skill acquisition and in terms of intellectual development (*Questionnaire 3*, Fall 1987, N=906).

In the Winter 1988 semester, all students who had left the University of Guelph between Fall 1986 and Winter 1988 who could be found, were contacted for a telephone interview to ascertain the leavers' exact locations within the post-secondary system or the labour force and to ascertain reasons for the change of plans (*Interview 1*, Winter 1988, N=264).

A fourth survey received additional funding from the *Social Sciences and Humanities Research Council of Canada*. The new project, ***Student Characteristics, Institutional Structures and Educational Outcomes***, extended the initial research and broadened its focus. In the winter semester of 1990 students received a final questionnaire which measured prior-to-graduation educational outcomes and consequences (*Questionnaire 4*, Winter 1990, N=802).

The study design permits comparisons between stayer and leaver groups or, for that matter, among those required to withdraw, stayer and departure groups, based upon differential experiences at the University of Guelph and based upon social background characteristics such as gender. A wide range of behavioural and attitudinal variables are contained in the overall data set, including items from the student information system (SIS). Response rates to the total population (not sample) surveys have been good to excellent i.e. 70%, 70%, 48%, 45%, 60%, respectively. The focus of the initial research was upon student attrition and educational outcomes and results have been reported in a number of articles and papers (cf. Evers and Gilbert, forthcoming; Gilbert, 1989; Gilbert and Evers, 1989; Gilbert, Evers, and Auger, 1989; Gilbert and Auger, 1988).

The longitudinal data document that gender is an important and pervasive factor in student expectations, progress, program selection and satisfaction. In particular, women display greater levels of motivation to attain undergraduate degrees, perform better academically in high school, and initially in university, than men, yet have lower estimates of their academic ability and potential for graduate study than do men.

For the ***Gender Tracking*** project, a specific set of new questions was inserted in *Questionnaire 4* (Winter 1990) to measure educational experiences and outcomes, general values and specific attitudes, and to capture, retrospectively, the reasons and encouragements (role of significant others, role models, etc.) for the selection of science and non-science based programs. Career aspirations and overall assessments of students' experiences were also measured. These questions were designed with women in mathematics, science and engineering programs in mind, especially the high achievers. A copy of the Winter 1990 questionnaire, with the questions designed for the ***Gender Tracking*** project highlighted, is included as an Appendix to the report.

Qualitative in-depth interviews were conducted to supplement the quantitative survey data. All women high achievers who transferred out of ***CSP*** disciplines and an equivalent randomly selected sample of high achieving women stayers were targeted for detailed interviews concerning reasons, experiences, attitudes about science program features, and gender identity self-descriptions. Interviews were conducted with 20 of the 28 women high achievers who transferred out of ***Canada Scholarships Program*** disciplines and with 27 of the sample of 30 women high achievers who remained in ***CSP*** disciplines.

There are several points which must be kept in mind about the analysis and its relevance to the ***Canada Scholarships Program.*** The students under primary examination in the ***Gender Tracking*** project are not actual scholarship holders; instead they are high achieving male and female students who entered ***CSP*** or non-***CSP*** disciplines in 1986. These students are part of a total entering student cohort at a single institution, the University of Guelph. While initial survey numbers are large, when the findings involve specific sub-groups such as women 'A' students in science who have transferred to non-science programs, to take an example, the numbers become small. The entering degree program distribution for all new, first semester students in the Fall of 1986 is presented in **Table 3.1.**

Table 3.1

Program Enrollment According to Gender

Program %	Women	Men	Total	
			N	%
B.Sc.(Agr.)	39%	61%	217	(7.5)
B.Sc.(Eng.)	20%	80%	41	(1.4)
B.L.A.	50%	50%	6	(0.2)
Diploma (Agr.)	20%	80%	151	(5.2)
B.A.Sc.	88%	12%	266	(9.2)
B.Comm.	69%	31%	90	(3.1)
Prevet.	90%	10%	10	(0.3)
B.A.	57%	43%	836	(29.0)
B.Sc.	51%	49%	764	(26.5)
General studies	49%	51%	272	(9.4)
Unclassified	60%	40%	116	(4.0)
B.Sc.(Human Kinetics)	52%	48%	105	(3.6)
TOTAL %	54%	46%	-	(100)
N	1556	1318	2874	-

Women represented 39% of new enrollment in the B.Sc. (Agr.) program, 20% in engineering, and 51% in the B.Sc. program which includes both physical and biological sciences. **Table 3.2** displays gender participation rates in ***CSP*** and Non-***CSP*** disciplines. As anticipated, women are underrepresented in the science disciplines and overrepresented in the non-science disciplines.

Table 3.2

Science (CSP) and Non-Science (-CSP) Programs By Gender

Program	**Women**		**Men**		**Total**	
	N	**%**	**N**	**%**	**N**	**%**
Science	484	31	538	41	1022	36
Non-Science	1072	69	780	59	1852	64

4. FINDINGS

The results are presented according to issues surrounding recruitment and retention. First, the findings deal with the relationships between gender, program choice, and program experiences for science and non-science students. Second, within science gender patterns by achievement levels are examined. Section three reports relationships concerning gender, achievement, and experiences in science. Finally, results are presented which link gender patterns to educational outcomes and destinations, i.e., retention.

The first section gives a comprehensive overview of the findings for all factors included in the study. The analysis in the remaining three sections emphasizes those factors most relevant to the issues of recruitment, achievement, and retention within science.

4.1. Gender, Discipline Choice and Program Experiences.

This section explores the relationship between gender and choice of, and experience in, educational programs. Various psychological and motivational factors are examined and compared for all women and men in science and non-science programs. The analysis proceeds by considering:

- general work/ study values;
- self-perceptions concerning basic levels of competence or performance on discipline-related skills;
- perceptions of important abilities required in students' chosen fields of study;
- factors influencing students' choice of educational program;
- attitudes towards science;
- career aspirations; and

- high school and university experiences.

As previously discussed, two fundamental value constellations have been identified in the literature. The first, a ***response and care orientation***, is said to be more characteristic of women than men in that women have a greater commitment to establishing and maintaining relationships and pay more attention to the context within which such relationships exist. Similarly, the second value pattern, a ***justice and rights orientation***, is said to be more characteristic of men than women in that men stress abstract, detached, competitive, and logical activities and environments.

A comparison between the gender patterns for students entering science versus non-science programs (Table A4.1.1.)[1] shows that there are substantial gender differences,

Table 4.1.1

Gender Differences in Basic Values By Program

Basic Values	Women		Men	
	Non-Science	Science	Non-Science	Science
Relationships	83%	72%	55%	67%
Supportive environment	57%	46%	30%	23%

particularly concerning the ***response and care orientation*** and, interestingly, particularly for students entering non-science programs. **Generally, women in both programs to a greater extent than men exhibit an interest in relationships with other people, caring for others, working in a supportive environment, etc. There are also important within gender variations across programs** (see **Table 4.1.1**). For example, eighty-three per cent of women non-science students indicate that they value relationships a great deal (category 5 on a 5-point scale) compared to seventy-two per cent of women science students. Fifty-seven per cent of women non-science students indicate that they value working in a supportive

[1]The 'A' in **Table A4.1.1** indicates that the table is in the *Appendix*. Tables that appear in the body of the report do not have an 'A' preceding the number.

environment a great deal compared to 46% of women science students. The gender differences concerning the ***justice and rights orientations*** are much weaker but generally in the expected direction, with men more than women expressing a preference for these values.

Students were asked to estimate their level of competence or performance on a number of cognitive, self-management and interpersonal aspects (Table A4.1.2). **Generally, men more than women in both the sciences and non-sciences rate themselves higher on cognitive aspects while women to a greater extent than men in both the sciences and non-sciences rate themselves higher on self-management and interpersonal aspects.** There are, however, some notable differences between students in scientific/engineering disciplines and students in non-science disciplines. In terms of *thinking and reasoning* and *problem solving* skills the gender pattern is twice as strong in the sciences compared to the non-sciences. To illustrate the within science gender differences, 23% of male science students compared to 15% of female science students rate themselves in the top 'extremely high' category on *thinking and reasoning* skills as do 19% and 13% of male and female science students, respectively, on *problem solving* skills.

Students were also asked to indicate how important a series of abilities or capacities were in order to be successful in their chosen field of study (Table A4.1.3). Women, overall, rate the dimensions as more important than men do. The only exceptions involve women in science who rate ability in mathematics, mechanical abilities and problem solving ability lower than do men in sciences, however, the gender relationships for these items are not strong. Seventeen per cent of men in science state that ability in mathematics is extremely important (5 on a 5-point scale) compared to 8% for women in science.

Certain gender patterns are stronger in the non-sciences than in the sciences while for other specific items the reverse is the case. The gender relationship or the extent to which women more than men perceive certain capacities and abilities as important, is stronger in the the non-sciences than in the sciences for the following: general academic ability, open-mindedness, ability to persevere, planning and organizational ability, reliability, high moral

standards, ability to get along with others, ability to communicate orally, ability to communicate in writing, ability to assert oneself, ability to help others, and finally, ability to adapt. On the other hand, women in science to a greater extent than men in science rate an enquiring mind, ability to work long hours, desire to work independently, and ability to work independently, as important capacities to a greater degree than women versus men in non-science.

Equally important are the differences between women science and women non-science students (see **Table 4.1.2**). **For example, 62% of female non-science students state that it is extremely important in their field to have the ability to communicate orally, compared to 30% of female science students. Similarly, 38% of women non-science students and 12% of women science students feel that the ability to help others is extremely important.**

Table 4.1.2

Abilities Perceived as Important by Program

Capacities	Women		Men	
	Non-Science	Science	Non-Science	Science
Oral communication	62%	30%	38%	23%
Ability to help others	38%	12%	15%	10%

Students were asked to rate a variety of factors as important or unimportant in selecting their chosen field of study. Categories of items of influence included home, high school, students' assessments of their abilities, career experiences and perceptions and expectations concerning future consequences or outcomes. By and large, the gender pattern of response in both kinds of programs shows that women rank most influences as more important than men and that this relationship is stronger for most items of influence for non-science students than for science students (Table A4.1.4). There are, however, some notable

exceptions which are indicated below. The gender pattern is stronger in the non-science areas for home influences, communication and interpersonal abilities and especially for the item *to respond to the needs of others* (see **Table 4.1.3** below). In the non-sciences 34% of women respond that this was a very important (5 on the 5-point scale) aspect influencing their choice of undergraduate major; in the sciences 15% of women and 5% of men respond this way.

Table 4.1.3

Influence Upon Discipline Choice by Program

	Women		Men	
	Non-Science	Science	Non-Science	Science
Respond to others needs	34%	15%	13%	5%

Items where the gender relationship is stronger for science students than for non-science students include good marks in high school, writing abilities, expectation of future good marks, and the desire to be self-sufficient. Concerning the latter item, 46% of female science students indicate that this aspect was very important in selecting their field of study compared to 26% of male science students, 40% of female non-science students and 34% of male non-science students.

Weak gender patterns exist concerning career aspirations and influences (Table A4.1.6). Men in science to a greater extent than women in science may take a professional degree related to their major while the reverse is the case in non-science areas. Similarly,men in science more than women in science may leave university and choose work unrelated to their major or may find a job in their area of study in government, whereas the reverse is true for women and men in the non-science areas. Concerning employment in education, the gender gap favouring women is stronger in the non-sciences than in the sciences. Interestingly, men more than women expect to leave university and not join the labour force

and this pattern is stronger in the sciences than in the non-sciences. **In terms of the difficulty of combining family and career, there is a stronger gender relationship in the sciences than in the non-science areas. Women anticipate more difficulty in combining family and career responsibilities.** Finally, intentions about a specific area of study/work emerged later for men than for women in the non-science fields and there was no relationship overall for the sciences.

Table 4.1.4

Gender of Instructors & Role Models in High School[12] for High Achieving Women, by Program

Category	%Science	%Non-Science
Instructors		
Mainly women	8	6
Mainly men	53	43
Equally women & men	39	51
N=	(66)	(47)
Role Models		
Mainly women	15	24
Mainly men	39	21
Equally women & men	46	55
N=	(61)	(47)

As **Table 4.1.4** and **Figures 4.1.1a and 4.1.1b** show the educational experiences of women and men in high school and university vary according to the program of enrollment. High achieving women science students primarily had men instructors in high school (53%) whereas high achieving women non-science students primarily had equal numbers of women and men instructors (51%). The differences are more interesting concerning role models; only 15% of high achieving women in science had mainly women role models compared to 24% in

[2]Students were asked if their instructors or role models in high school were "mainly women", "mainly men", or "equally women and men".

the non-sciences. Conversely, 39% of high achieving women in science had mainly male role models in high school compared 21% of high achieving women in non-science disciplines. Undoubtedly these findings reflect the preponderance of male high school teachers in mathematics and science courses.

Figure 4.1.1a
Gender of High School Role Models for Science Students

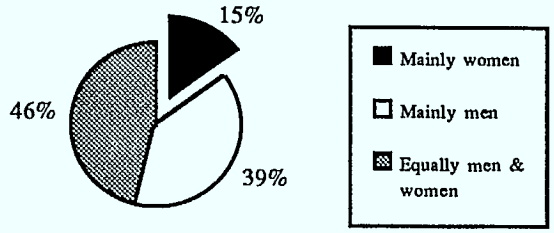
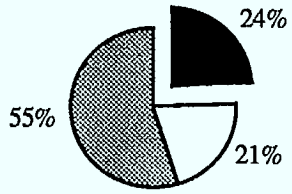


Figure 4.1.1b
Gender of High School Role Models for Non-Science Students



Male and female students also tend to experience university differently depending upon the program of enrollment. In the non-science fields women more so than men regard friendships/social life, course content and especially formal learning as positive aspects of university. **In the sciences women to a greater extent than men regard academic stress and personal difficulties as negative aspects of university life** (Table A4.1.8).

There are other interesting within-program and across-program differences (Table A4.1.9.). **Female science students by a wide margin over male science students view personal growth as the most positive feature of university and academic stress as the most negative feature.** If the past few years of university could be relived, women science students would have better study habits while male science students would study harder. Males in science appear to exhibit greater attachment to their field of study than do females in science. When students were asked if they felt their questions and comments were

understood in class more women in the non-sciences (22%) than in the sciences (14%) responded "Yes, definitely." **Women in the non-science areas have a more positive response than women in the sciences regarding the relevance of courses for their careers or for their personal development (Table 4.1.5).**

Table 4.1.5

Relevance of Courses and Skills For Women By Program

	Women in Science	Women in Non-Science
Course Content		
Extremely relevant to career	8%	12%
Extremely relevant to personal development	10%	18%
Skills Developed		
Extremely relevant to career	13%	23%
Extremely relevant to personal development	8%	25%

A **summary** of the major findings concerning gender, discipline choice and program experiences for all science and non-science students is:

(1) Women in science and non-science programs exhibit, to a greater extent than men, a response and care value orientation which emphasizes personal relationships, caring for others, working in a supportive environment.

(2) Women in non-science programs have these values to a greater extent than women in science programs.

(3) Women in non-science programs to a much greater extent than women in science indicate that *to respond to the needs of others* was an important influence in selecting their field of study.

(4) Women in science more than men in science indicate that good grades in high school, the expectation of good grades in university and a desire to be self-sufficient were important influences on their choice of discipline.

(5) Women anticipate more difficulty than men in combining family and career responsibilities and the gender gap is greater in the science disciplines than the non-science disciplines.

(6) Women science students by a wide margin over men science students view academic stress as the most negative feature of university.

(7) Women in science disciplines less so than women in non-science disciplines consider their course content and skills acquired to be relevant to their careers and to their personal development.

4.2: Recruitment: Gender Patterns within Science

This section extends the analysis of the factors associated with student recruitment to science by examining the within science gender patterns according to students' high school academic achievement levels. Results are reported for: 'A' students in science, that is, those with entering high school marks of 80% or above; 'B+' students with entering high school marks between 75% and 79%; and 'Other' students with entering high school marks of 74% and below. This section assesses the extent to which the general differences and similarities among female and male university students that influence recruitment into science exist also among science students of differing academic achievement.

Four factors are especially relevant for understanding recruitment into science within categories of gender and academic achievement:

- ❑ students' own perceptions of the importance of pre-university influences and considerations such as family, high-school experiences, self-assessment of ability, and perceptions and expectations about university while in high-school ;
- ❑ students' perceptions of the abilities needed for success in science ;

- students' self-assessment of their own abilities once in university ; and
- students' value orientations towards self and others.

The strongest and most consistent set of gender differences involve the kinds of pre-university influences that female and male students report as affecting their program choices (Table A4.2.1). Females attribute more importance than males to almost all pre-university factors (such as home and high school influences, self-assessment of their abilities, and their perceptions and expectations concerning university and post-university life). The two main exceptions to this are (1) cognitive abilities and (2) previous full-time and summer employment experiences. For these factors the gender differences are small or are rated more highly by males.

With respect to people who played an important role in affecting their decision to major in science, females attribute greater importance than males to mothers, fathers, high school teachers, and high school guidance counsellors. **High achieving women science students were much more likely than men to cite high school teachers as influencing their decision to major in science.** More high achieving women (15%) than men in science had mainly women role models. None of the high achieving men in science had female role models. However, 80% of the men had mainly male role models whereas only 39% of women did (Table A4.2.7 and **Figures 4.2.1a & 4.2.1b**).

Figure 4.2.1a
Gender of High School Role Models for High Achieving Women Science Students

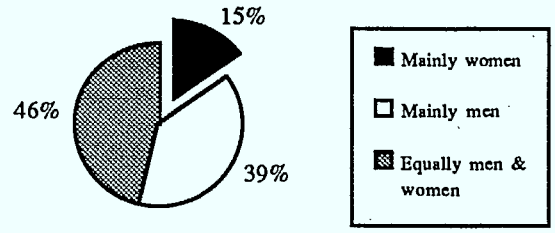
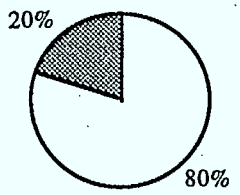


Figure 4.2.1a
Gender of High School Role Models for High Achieving Men Science Students



Gender differences are smallest with respect to the influence of peers. This does not mean necessarily that peers had a less important influence on students' choices of academic programs than did parents or teachers, although other research would support such an interpretation. It does mean that peers were about equally important (or unimportant) for females and males whereas parents and school officials played a more important role in the choices of females. Neither do these patterns mean that females choosing to major in science received more support than their male counterparts from these sources, possibly because lower levels of confidence about their abilities motivated them to seek reassurance from parents and teachers. These findings indicate that women attach more importance than men to the social support they receive, whatever the actual level of support.

To illustrate, consider students' perceptions of the influence of high school grades. The importance attributed to the influence of high school grades reveals some large gender differences. While females and males with high school entry grades of 80% or higher received similar 'amounts' of marks, the women students were much more likely than the men to cite

grades as an important factor influencing their decision to major in science. Similarly, although females and males with high school grades between 75% and 79% received similar grades, females were much more likely than males to note the importance of grades as a factor encouraging them to major in science. A similar, if slightly weaker, pattern emerged for those science students with high school entry grades of 74% or less. Also, females more so than males, cite *expectations of good marks* once they enter university as an important pre-university influence upon their choice of discipline. The size of the gender difference varies by high school academic achievement.

Whether females or males had more interest in science while in high school is open to debate. What the data reveal is that females, especially women in the higher achieving categories (i.e., 'A' and 'B+' Science Students), attribute greater importance to their interest in science as a factor influencing their recruitment into science. High achieving women in science, particularly those in the 'A' category, attribute greater importance to the influence of the desire to be *self-sufficient in the future.*

A consideration of factors other than students' reports of important pre-university influences provides useful insights into why males and females choose science programs. Two other factors are students' perceptions of (1) the competencies needed to do well in their science program and (2) their own abilities (Tables A4.2.2 and A4.2.3).

Men relative to women tend to stress the importance of cognitive abilities for success in science programs although, with few exceptions, the gender differences are not large. Women in all three achievement categories (i.e., 'A', 'B+', and 'Other') on the other hand consistently rank *an enquiring mind* higher than men do. Women relative to men tend to give greater importance to self-management (especially the *desire to work independently*) and interpersonal abilities (most notably the *ability to help others*).

An interesting feature of the above patterns is how they mirror students assessments of their own abilities. Men generally rate themselves higher than women rate themselves on cognitive abilities while women rate themselves higher on self-management abilities.

Taken together, students' perceptions of the abilities need to do well in science and of their own abilities suggest that: (1) female and male science students have different perceptions of the abilities required to succeed in university science programs; (2) females and males also rate their own abilities differently; and (3) the two ratings correspond to each other in that the competencies each gender identifies as important for success in science programs corresponds to the abilities each identifies as especially well developed within its own gender. **Men tend to emphasize *cognitive* abilities as necessary for success in science and also tend to rate themselves higher than women on these characteristics. Women tend to emphasize *self-management* and *interpersonal* competencies as a basis for success in science and also tend to rate themselves higher than men on self-management competencies.**

It may be that students choose programs which will permit them to use their existing competencies. However, men and women have different images of the abilities science programs will allow them to employ. Although men and women select the same program they may have different images of what the program entails and of what the program will allow them to do. In this sense men and women science students are selecting the 'same' program but for different reasons. The mechanisms of recruitment for women appear to differ from those for men. Men's and women's decisions to major in science are based upon different sets of considerations. The two genders have different images of what science is and what it will allow them to do. If the programs respond effectively to the full range of expectations then this may not matter. However, if one set of images is more accurate than the other, then one group may find itself disadvantaged.

The final major influence on recruitment discussed here is basic value orientations. To what extent do men and women in the sciences differ in terms of orientations to self and others (Table A4.2.4)?

The expectation emerging from the literature in this area is that women will tend to respond more positively to the ***response and care orientation*** items than will men. In general

this expectation is met. On 18 of 24 possible values, women science students respond more positively than men. It may be noteworthy that the differences between women and men are much stronger for the 'A' achievers than for the other two achievement categories regarding *working in a supportive environment* and *having harmony in the work/ study environment.*

In terms of the ***justice and rights orientation*** it is anticipated that males more than females will respond positively to these items. The gender patterns here are not nearly as clear cut as with the ***response and care orientation***. Overall there are smaller gender differences concerning ***justice and rights orientation***. Of 24 possible value value dimensions, only 10 favour males. There is, however, a slight tendency for male science students in the higher achievement categories to have a ***justice and rights orientation*** to self and others.

Supporting evidence for the existence of these gender differences and their possible implications can be found in students general and specific perceptions of science (Table A4.2.5). Overall, men place greater emphasis upon the value of science for rationality and instrumental factors, such as an *improved standard of living*. Women place greater emphasis upon *facilitating consumer choices*. For the 'A' students, males had a much more positive attitude than females towards science. Additional evidence comes from students' perceptions and expectations about the future (Table A4.2.1). There is a large gender gap concerning *desire to be self-sufficient.* Women valued this more, especially high achieving women. Moreover, while the gender difference is weaker on *to respond to the needs of others*, it is consistent across all achievement categories of science students showing that women consistently place a greater emphasis on this aspect. One interpretation of these response patterns is that they may reflect a different kind of concern among women for relationships to others.

The implication of these differences with respect to recruitment is similar to the one raised in terms of the issue of personal competencies and the abilities perceived as necessary for success within science. **Women and men choose and enter science programs with different perceptions and values of self and others. Both groups expect science to**

provide them with a way of acting on their respective perceptions, expectations, and value orientations.

This section examined the factors influencing the recruitment of females and males of varying academic ability into science programs. The main general conclusion is that males and females arrive in science programs through different routes:

(1) The pre-university influences affecting recruitment is different for females and males. Females are more responsive to support from others, demonstrated academic competence, and self-assessment of their self-management and interpersonal competencies. Males are more responsive to the self-assessment of their cognitive abilities.

(2) High achieving women in particular are more responsive to the influences of good grades in science, encouragement from high school teachers and a desire to be self-sufficient than were high achieving males.

(3) Males and females have different images of the competencies they think science will reward. Men feel science will reward cognitive competencies; women focus on self-management. Both genders believe that science programs will reward the competencies they feel they have. Males and females enter science with different value orientations to self and others. Women tend to have a response and care orientation which stresses the connection of self to others while, less clearly, men have more of a rights and justice orientation with a greater emphasis on the autonomous self. Both men and women enter science expecting to be able to live educational, and subsequent occupational, lives in science in accordance with these value orientations.

(4) Female students in the highest achievement category ('A') value working in a supportive environment and having harmony in their work/study environment much more so than comparable male students.

Although both men and women are recruited to science programs, they respond to different calls. This raises the question of whether the educational experiences associated with science education should and can respond effectively to these differing values and needs. And what are the consequences of failing to do so? This leads to an examination of what happens to students after entering university.

4.3: Gender, Achievement, and Experiences in Science

The ***Canada Scholarships Program 1989-90 Report Card*** notes that of the 2500 1988 scholars 51% were female and 49% male. However, 64% of the males entering second year studies renewed their scholarships while only 46% of the females did so. This trend was reproduced by the 3340 scholars in the 1989 first year cohort, 52% of whom were female. Of this group, 63% of the males and only 46% of the females going on to second year renewed their scholarships. However, for the 1988 scholars going from second to third year, 82% of the male scholars and 76% of the females scholars renewed their scholarships. The ***Report Card*** notes that "88% of the non-renewed 1988 Canada Scholars failed to attain first-class standing during their first year of studies" (Industry, Science and Technology Canada, 1990: 2, 30).

If anything, the grade related experiences of the students in the Guelph sample were even more dramatic than those experienced by the **CSP** scholars. Final high school grade averages of female and male science students were cross tabulated against university semester averages for the Fall 1986, Winter 1987 and Fall 1987 semesters (**Tables 4.3.1a & 4.3.1b.**). Only those students achieving a final high school average of 80% (the 'A' students) or between 75% and 79% (the 'B+' students) were included in the calculations.

The data reveal a considerable drop in academic performance for men, and especially for women, between high school and university. Moreover, this drop

continues over the first few semesters. (see **Figure 4.3.1a**). Of those students entering with an 'A' high school average, only about a third of the women maintained the 'A' average for the first university semester, compared to just over half the men. Moreover, 44% of these women and 31% of the men achieve Fall 1986 university averages below 75%. By the Fall 1987 semester, only 21% of high achieving women maintained an 'A' Average. The male rate had dropped even more dramatically to 17%. At the other end of the scale, 58% of women and 45% of men receive Fall 1987 university semester averages below 75%. Those students entering with a 'B+' average exhibit a similar pattern with the early drop being greater for women than for men and continuing in the first few semesters. The gender differences within this group are not as large as for the 'A' students and in the first semester the marks drop to below 75% for 88% of the women and 77% of the men.

Another way of summarizing the above is that men in science do better at retaining their 'A' average or at bettering their 'B+' entering average between high school and early university. As mentioned, 53% per cent of male high achievers receive grades in their first university semester in the same grade category compared to 31% of women. For the 'B+' entering students, 14% of men and 8% of women receive mark averages in the same category for the Fall 1986 semester and 9% of men and 3% of women do better, that is, achieve an 'A' average.

Table 4.3.1a

Gender and Early University Academic Achievement for Science Students with High School Entry Grades above 80%

	University Semester					
	Fall '86		Winter '87		Fall '87	
Average in University	Female	Male	Female	Male	Female	Male
80+	31	53	29	33	21	17
79-75	25	16	21	30	21	38
74-50	40	31	47	32	57	45
<50	4	-	3	5	1	-
Total (%)=	100	100	100	100	100	100
N=	(104)	(89)	(103)	(90)	(95)	(77)

Table 4.3.1b

Gender and Early University Academic Achievement for Science Students with High School Entry Grades between 75% and 79%

	University Semester					
	Fall '86		Winter '87		Fall '87	
Average in University	Female	Male	Female	Male	Female	Male
80+	3	9	5	6	2	8
79-75	8	14	9	12	6	18
74-50	83	74	83	72	92	70
<50	5	3	3	9	-	3
Total (%)=	99	100	100	99	100	99%
N=	(96)	(66)	(92)	(65)	(87)	(60)

Table 4.3.2a

Gender and Later University Academic Achievement for Students with High School Entry Grades above 80%

	University Semester					
	Winter '89		Fall '89		Winter '90	
Average in University	Female	Male	Female	Male	Female	Male
80+	32	36	28	31	29	30
79-75	21	27	34	29	38	36
74-50	46	36	38	38	33	33
<50	1	–	–	2	–	1
Total (%)=	100	99	100	100	100	100
N=	(82)	(66)	(92)	(68)	(93)	(73)

Table 4.3.2b

Gender and Later University Academic Achievement for Students with High School Entry Grades between 75% and 79%

	University Semester					
	Winter '89		Fall '89		Winter '90	
Average in University	Female	Male	Female	Male	Female	Male
80+	12	10	14	10	19	14
79-75	17	18	22	30	29	30
74-50	71	72	64	60	52	54
<50	–	–	–	–	–	2
Total (%)=	100	100	100	100	100	100
N=	(70)	(50)	(73)	(53)	(77)	(57)

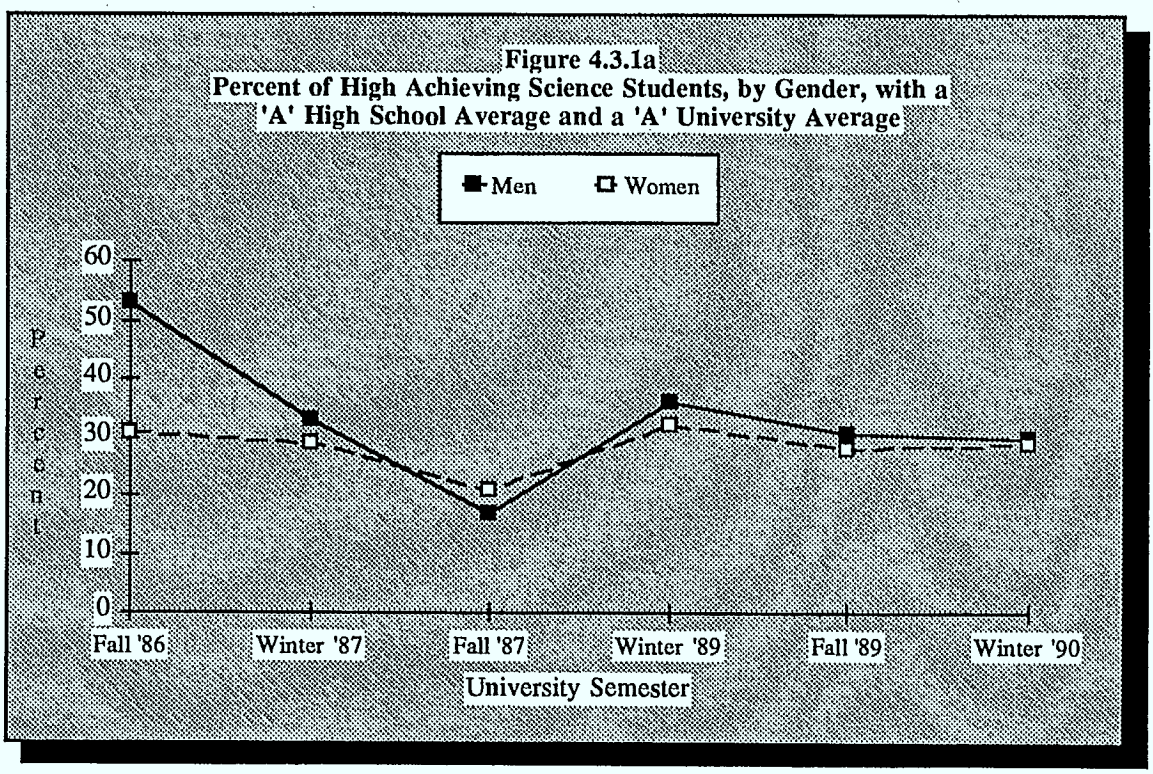


Figure 4.3.1a
Percent of High Achieving Science Students, by Gender, with a 'A' High School Average and a 'A' University Average

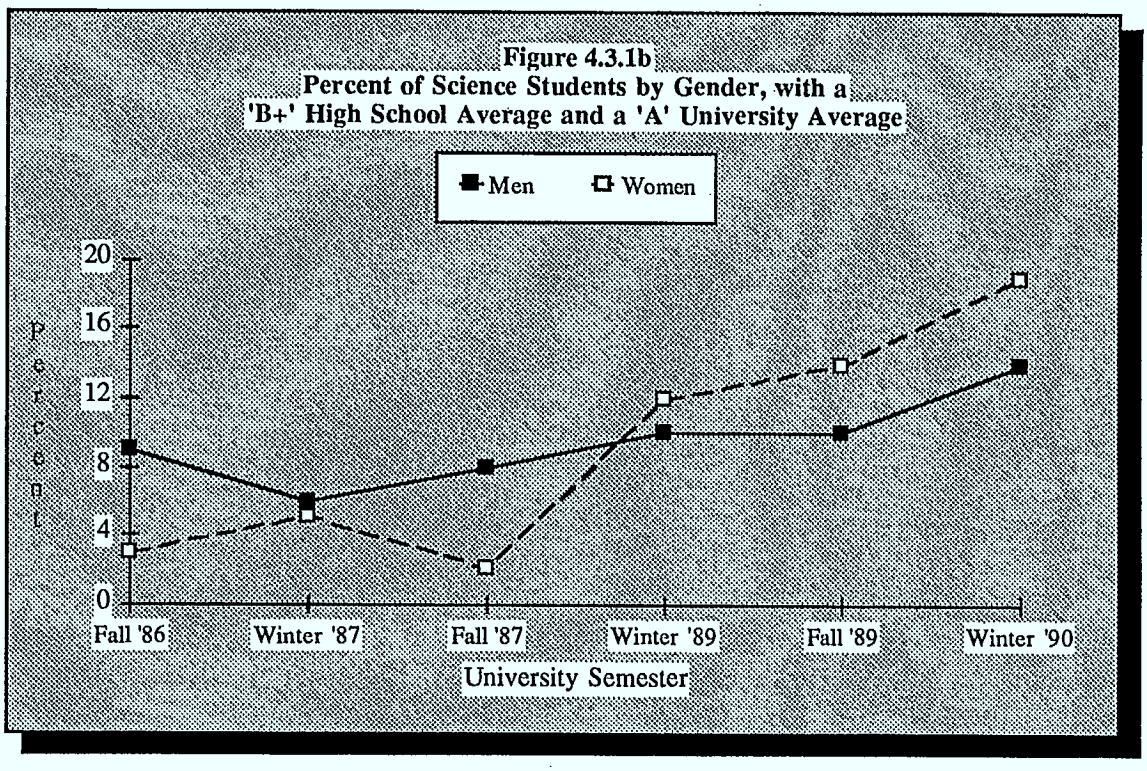


Figure 4.3.1b
Percent of Science Students by Gender, with a 'B+' High School Average and a 'A' University Average

A third noteworthy pattern is that over time (examining Winter 1987 and Fall 1987 university grades) the gender pattern weakens for the 'A' students and strengthens for the 'B+' students. For the Fall semester of 1987, one full year after university entry, 17% of high achieving males and 21% of high achieving females receive top grade averages. However, for the 'B+' entering group the balance is more strongly in favour of males, with 8% doing better than their high school marks and 18% doing as well compared to 2% and 6% of women, respectively.

Given this situation regarding early grade achievement, what happens later at university? **Tables 4.3.2a & 4.3.2b** presents comparable information for the Winter 1989, Fall 1989 and Winter 1990 semesters. A number of observations arise from this table and from a comparison with the findings on early academic achievement. **First, the drop in performance is not as severe. The magnitude of the drop in achievement has not persisted over time and in certain respects grades are improving.** Compared to the Fall 1987 grades, about one third of the 'A' students at entry receive 80+ university averages and fewer have dropped to other grade categories. Similarly, more 'B+' students have improved or maintained their level over these semesters than was the case early on. **Second, there is now a considerably smaller difference between men and women in science in the 'A' achievement group.** In fact, in each later semester a higher percentage of women than men in the 'B+' entering student group achieve 'A' averages at university. The gender gap has essentially disappeared. It certainly has not accentuated for the 'B+' group as was the case with early university achievement.

The magnitude of the drop in grades at Guelph was greater than the drop experienced by the **CSP** scholars. This should not obscure the fact that the gender patterns were very similar. In the early stages (roughly the first year and a half) women experienced greater grade declines than men, and fewer grade increases. However, the gender differences lessen, in some instance considerably, in the latter years, with the 'A' female students regaining some lost territory and the 'B+' actually gaining.

These achievement patterns are reflected in the response of male and female high achievers to the survey questions concerning positive and negative aspects of university (Tables A4.3.8. and A4.3.9). **University is experienced differently by men and women high achieving science students For example, male 'A' students respond much more positively than female 'A' students concerning the following positive aspects of university: academic success; career development; and informal learning. Women high achievers, especially the 'B+' group, on the other hand, respond much more negatively than men regarding academic stress and personal difficulties as unpleasant aspects of their university experience.** The response to whether questions and comments were understood when raised in class (Table A4.3.9) indicates that among high achieving science students, women (9%) were much less sure than men (23%) that this happened. The question concerning the relevance of course content to career and personal development reveals a low level of positive response, especially for women. The pattern is similar concerning skills developed. When asked what they would do differently if they could relive the past years, women in science indicated that it would be more a case of better study habits than studying harder. What are the consequences or outcomes for students of these and other gender differences?

4.4. Retention: Program Leavers, Changers, and Persisters

Table 4.4.1 presents a summary of the educational destinations of the total Fall 1986 entering student cohort according to program, gender and entering academic achievement level. Students are categorized as *Leavers* (those who have left the University), *Changers* (those who have switched programs; science to non-science and vice versa), and *Persisters* (those who remained in their original program). The data reveal that, for all women, there are slightly more science leavers (30%) than non-science leavers (27%) and considerably more

Table 4.4.1

Educational Destinations by Program, Gender and Academic Achievement

Program Behaviour	All Students				High Achievers				Other			
	Women		Men		Women		Men		Women		Men	
	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS
Leavers	30	27	30	39	13	19	13	34	43	29	37	39
Changers	12	02	13	02	12	03	15	04	11	02	12	02
Persisters	58	71	57	59	75	78	72	63	46	69	51	59
N=	(471)	(888)	(522)	(638)	(203)	(214)	(159)	(83)	(268)	(674)	(363)	(100)

changers or transfers out of science (12%) than transfers out of non-science programs (2%). For all men, there are more non-science leavers (39%) than science leavers (30%) and about the same level of program changing as for all women, 13% and 2% in this case. The overall pattern for all women in science and all men in science is almost identical. For women high achievers (those with an entering high school average of 75% or better), there are more non-science leavers (19%) than science leavers (13%) and more science changers (12%) than non-science changers (3%). This same pattern holds for male high achievers but the differences are accentuated, 34% versus 13% and 15% versus 4%, respectively. Again, very similar figures exist for both women and men. For women with entering grades below 75%, there are considerably more science leavers (43%) than non-science leavers (29%).

Table 4.4.2 further refines the analyses by breaking the high achieving group of students into A and B+ categories for science students. Of the B+ women science students 17.5% leave the university and 9.3% change to non-CSP disciplines. However, of the A women science students only 8.5% leave and 24.5% change to non-CSP disciplines.

Table 4.4.2

The Association in Percentages between Gender and Program Behaviour for Science Students controlling for Initial Entry Grade

	High School Average upon Entry into Science			
	A		B+	
	Gender		Gender	
Program Behaviour	Female	Male	Female	Male
Leavers	8.5	15.4	17.5	10.3
Changers	24.5	22.0	9.3	16.2
Persisters	67.0	62.6	73.2	73.5
Totals (%)=	100	100	100	100
N=	(106)	(91)	(97)	(68)

The overall pattern of the impact of high school grades upon program persistence, leaving university or changing to non-CSP disciplines within the university for male and female science students is: (a) that grades have an effect upon both male and female program persistence and, (b) the effect of grades upon program behaviour is greater for women than for men. The retention of female science students is more likely to be influenced by initial entry grades than is the retention of male science students. This is consistent with the previous discussion of the influence of marks upon recruitment. Women's selection of science disciplines are influenced by their high school grades and by an expectation of good grades at university.

Detailed, individual level analysis shows that a large number of high achieving (75+ entering average) women changing from CSP disciplines to non-CSP disciplines are transfers from science programs to veterinary medicine and human kinetics programs where the science courses represent pre-requisites or a fall-back option. In depth, qualitative information from these students concerning their university experiences and their program decisions is presented later in the report.

What is the relationship between the ***response and care orientation*** and the departure of high achieving women from science programs? Women high achievers who departed from science programs had much more of a response and care orientation than those who persisted in science (Table A4.4.1.2). The difference was particularly large for the *working in a supportive environment* dimension.

As reported earlier, men in science perceive themselves to be more competent than women in terms of cognitive capacities, whereas women tend to rate themselves as more competent than men in self-management and interpersonal functioning. To what extent do these factors affect the retention of women high achievers in science programs? The high achieving women who depart, that is the leavers and the program changers, rank themselves higher on all three competence or performance aspects than do the persisters, but particularly on the self-management and interpersonal aspects (Table A4.4.2.2). It may be the case that perceived cognitive competencies do little to retain high achieving female science students, while perceived competencies in self-management and interpersonal areas lead high achieving women to look to other programs which reward these characteristics.

An interesting pattern exists concerning high achievers' perceptions of the abilities required for success in science. Overwhelmingly, the high achieving women who depart from science rank almost all of the abilities as more important for success in science than do those high achieving women who remain in science. One notable exception concerns *ability in mathematics* where the reverse is the case; the high achievers who stay feel that this aspect is more important for success in science than those who leave (Table A 4.4.3.2).

It is plausible to interpret these findings to mean that women who rank such program requirements high are also worried about their ability to meet these requirements and thus are likely to leave. But as we saw earlier, those women who ranked themselves higher on these abilities were the ones most likely to leave. An alternate possibility is that women perceive the need to have certain abilities to do well in science, and even feel they can fulfil them, but prefer to express these competencies in other forums, i.e., other academic or non-

academic settings. **Some intellectually able women may leave science not because they feel they cannot meet certain requirements, but because they do not value displaying such abilities within the context provided by university science education. It is not so much a matter of ability as a case of preference or fit.**

A noteworthy expectation of high achieving women who enter science programs which is associated with retention, is the expectation of continued good marks in the subject. High achieving women who left had this expectation to a much greater extent than high achieving persisters (Table A4.4.4.2).

By way of summary:

(1) Women and men tend to have different value orientations to self and others. Although both genders are able to think and behave in ways that are characteristic of both orientations, men generally prefer to think and act in ways congruent with an orientation of ***justice and rights*** which emphasizes one's separateness from others. Connections are established through a set of socially defined and sanctioned general principles designed to ensure a reciprocity of categorically grounded rights and obligations. Women favour an orientation of ***response and care***. This orientation stresses one's ongoing involvement with others simply as a result of co-existence and values the ability to establish, develop, and maintain relationships in response to situationally specific exigencies. Although both men and women are equally able to perform the cognitive correlates (i.e., ways of thinking and knowing) associated with each of the value orientations, men tend to derive more satisfaction and value from a ***justice and rights orientation*** while women prefer the ***response and care orientation.*** If it is true that university science curriculums are premised on a ***justice and rights*** perspective stressing the development of an 'autonomous' self through the individual mastery of 'universal' problem solving procedures and knowledge oriented to mastery and control over the external environment, then women may feel less welcomed in such an environment than will men.

(2) The educational impact of this gender difference in basic value orientations to self and others seems to be threefold. First, to reiterate an earlier point, it affects recruitment into science in so far as men and women come to science with different values, expectations, images, and purposes. To the extent that university level science education responds more effectively to male than to female concerns, the difference in value orientations will have an indirect effect on retention in so far as as it results in the recruitment of individuals (including intellectually competent women) who experience difficulty in dealing with the (non-cognitive) social and value orientations of the educational environment.

Second, and related to the above point, retention is affected by this gender difference in value orientations in so far as men and women leave undergraduate science for different reasons even if the actual retention rates for each gender are almost identical. A concern here is that even intellectually competent women (more so than their male counterparts) may be leaving science partly in response to pressures related to differences in value orientations between themselves and their educational environments;

Third, the value orientation difference may have more of an impact on grade differences by producing initially much lower grades for women, with only a partial recovery later in their educational career. Women need time to construct an appropriate response to various unexpected and unsatisfying environmental features. To the extent that low marks influence women to quit science, and value orientation differences affect marks, then value orientations indirectly affect the retention experiences of women. The lack of fit between the value orientations of women and the science curriculum may be also a source of the high level of stress experienced by women.

Virtually all of the above themes are vividly illustrated in the qualitative interviews that took place with 20 of the 28 high achieving (75+) women students who left CSP disciplines and with 27 of a randomly selected sample of 30 high achieving women students who remained in CSP disciplines. Of the 20 leavers eleven went into veterinary sciences and 2 into human kinetics. The in-depth information was gathered to supplement the quantitative surveys with detail and texture. The interview schedule is included as an Appendix to the report. The comments received from these persisters and leavers are very valuable and will serve to amplify upon the findings presented.

Persisters and leavers were asked why they selected natural science and engineering programs and the responses are very instructive. A dominant response for women in both groups was that the program was necessary because it was a prerequisite for veterinary science. Other reasons were 'I was good at science and mathematics at high school', 'I always enjoyed sciences' and 'I wanted a challenging program".

The persisters were generally satisfied with their programs, had never really considered leaving and had few second thoughts about remaining in the programs. Any dissatisfaction centered around "...could have been more practical; a few courses were irrelevant"; "Program does not have practical experience. Suited more for people who want to do research" and, "We got a lot of theoretical labs; (should be) more hands on rather than theory". Thoughts about leaving the program occurred during the first year, when students were overworked and "After second year didn't feel 'smart' enough, felt incompetent".

Persisters were asked if they were enroled in a graduate program in science or if they had considered enrolling and if not, why. There was little desire for further study due to reasons like not interested, concerned about the job market and "Burned out, did not enjoy the theoretical part". When asked if they were working in a science-related area most persisters said they were not, because it was "Hard to find a job. I took what was accessible".

The non-veterinary science leavers indicate that considerations in leaving were: "I don't think the job market for science students is that good. I thought I'd better do something I like instead of working hard for a risky title"; "Marks (was doing poorly, C's and D's). Didn't like it due to lack of creativity, learning by rote; felt stifled"; and the following detailed response :

> As I said before I come from a science family. I felt that this field is always job oriented. I have always enjoyed arts courses. So I then realized maybe science was not all that important career-wise and that I could find a good job in English. I then decided that I would be happy teaching English, but only in an 'academic' setting. I would like to complete my Ph.D. It all came down to the fact that I no longer saw myself in the science model. I was loosing interest and the program was becoming harder and harder. It was mostly a career choice.

Leavers were asked what would it have taken to encourage or enable them to remain in the science program, did they have any second thoughts about leaving and are they more or less convinced that they made the right decision. Two interesting answers were:

> Felt useless in the science program, like a cog in the wheel; T.A's and profs patronizing-didn't care if someone did well or not; help not available if wanted. Profs in science openly articulated that "This class is a weeder class. Half of you won't be here in two semesters." To remain? Make people feel useful and people cared what and how students did.

> I had scholarships, I was being fully funded to complete my degree in physics. But I had to leave as there was nothing there for me anymore. My goals changed. I wanted more flexibility in the program, but physics is a strenuous discipline only allowing about two arts courses. If I could have taken more arts courses I would have stayed.

Again, students had few second thoughts about their course of action and were convinced that they had made the right decision on account of a greater interest in the new subject matter and the nature of the job market.

Positive events or situations which stand out in the minds of persisters and leavers regarding their total university experience revolve around the helpfulness of professors and classmates, friendships and bonding, small classes and group discussions and labs. For example, one of our interviewers noted that a respondent "Liked one of her women professors

who explained the material well, gave lots of assignments, was approachable, and had lots of office hours, offered help". Negative aspects were brutal examinations and failures on first midterms. Some of the high achieving women students commented that "My first exam was something", "Failure of the first midterm so shocking" , "Examinations are brutal...Teachers would tell you one thing and then the examination would be a big surprise" and "It's the students versus the profs and the system that is trying to weed them out".

A key set of questions on the interview deal with experiences in science programs which made a lasting impression, what aspects would students change about the programs if they had the power and what aspects should remain the same. The responses come together around 5 fundamental features:

1. The benefit of small, hands-on labs

- "Lab was a real life situation from which one could learn first hand knowledge"
- "The lab work really tied down the information which was given in class"
- "Chemistry labs, actually all labs. They might have been part of the reason why I've quit. It felt like there are tons of people - no individual attention. I didn't have a voice. I was shy"

2. A preference for small classes

- "My first year in university was so crowded. The physics course I took in first year, the students taught themselves the course. A lot of people failed that course"

- "Because the science classes are small women are drawn together to make companions. I feel that I made some good girlfriends because we were together as we had the same goals in life"

- "Make classes smaller because large classes are overwhelming and easier to let your mind wander"

- "Class size intimidated many but not me. Small classes did encourage discussions but how much discussion could we have on mathematical equations?"

3. Teaching: caring and personal contact were important

- Remembers a couple of exceptional profs who were "committed to their students' learning. They would change their methods to help people learn, bring in visual aids, encourage class participation." These were large introductory classes and the professors were male. The profs "memorized the names of students in the class and by the end of the semester they would know about 80% of the names". Led to a more personal relationship with the prof. Found the other sections of the course "migrating into these classes because they found the atmosphere more positive". Peers were very positive about the class.

- "The professors and TA's never saw us as potential equal human beings. If it happened that you meet someone who cares - you almost always miss out on making the best out of this knowledge, because it is so hard to believe"

- "Remove some of the profs who weren't interested in students"

- Liked third year and after because professor's attention was more personalized and atmosphere was "more intimate". The more involved she got in classes and clubs, the more satisfaction she got out of course and learned more.

- "Emphasis should be placed on teaching and not if the prof can publish enough. I feel that there are a lot of 'dead wood' at the University. The emphasis is more on researching rather than teaching"

4. Practical experience was valued

- "More practical experience"

- "Make courses have a manageable amount of material in them and more hands-on experience; speed writing versus hands-on"

- "Not enough practical courses"

- "Program is too general, too academic"

5. Greater flexibility

- "...the need to take courses outside the field of specialization"

- "I'd do away with killer chemistry"

- "Allow flexibility during the first year; more of a choice"

- "I believe in a multi-disciplinary approach to education although it is restrictive on specialization, thus harder to get a job"

- "Prerequisites should be relaxed"

6. Less memorization

- "Less memorization. All the material is already written down and the student has to memorize the booklet of small detail. Found rote courses to be the hardest courses to do well in"

- "Would change Zoology, particularly the memorization of the classifications. Found it extremely rote learning, therefore, boring"

- "I retained very little. We learn to memorize to get through exams, we do not learn to retain information"

- "Memorizing is futile and the more this is made easier, the better"

There were also some comments which brought together several of these themes: "A lasting overall impression was that science is for men because men are more logical and dominating. Felt this from other students and from professors" and, "Found multiple choice exams 'shocking' due to the culture shock of walking into large classrooms where the profs didn't care how one did. Didn't feel help was too willingly offered".

5. SUMMARY AND POLICY IMPLICATIONS

The analyses reveal significant gender patterns and within gender variation across and within educational programs and academic performance levels. There are gender differences in basic attitudes, values, motivations, social support, and perceptions of self and science that affect recruitment or discipline choice, experiences, achievement, retention or program behaviour, and career directions.

Women in science and non-science programs exhibit, to a greater extent than men, a response and care value orientation which emphasizes personal relationships, caring for others, and working in a supportive environment. Women in non-science programs have these values to a greater extent than women in science programs. Women in science more than men in science indicate that good grades in high school, the expectation of good grades in university, and a desire to be self-sufficient were important influences in their choice of discipline. Women anticipate more difficulty than men in combining family and career responsibilities and the gender gap is greater in the science disciplines than the non-science disciplines. Women science students by a wide margin over men science students view academic stress as the most negative feature of university. Women in science disciplines less so than women in non-science disciplines consider their course content and skills acquired to be relevant to their careers and personal development.

There are distinct gender patterns within entering achievement levels concerning the educational experiences of male and female students during high school and at university. The pre-university influences affecting recruitment into science disciplines is different for females and males. Females are more responsive to support from others, demonstrated academic competence, and self-assessment of their self-management and interpersonal competencies. Males are more responsive to the self-assessment of their cognitive abilities. High achieving

women in particular are more responsive to the influences of good grades in science, encouragement from high school teachers, and a desire to be self-sufficient.

Males and females enter science with different value orientations to self and others. Women tend to have a response and care orientation which stresses the connection of self to others while, less clearly, men have more of a rights and justice orientation with a greater emphasis on the autonomous self. Female students in the highest achievement category ('A') value working in a supportive environment and having harmony in their work/study environment much more so than comparable male students. Both men and women enter science expecting to be able to live educational, and subsequent occupational, lives in science in accordance with these value orientations. Males and females, however, have different images of the competencies they think science will reward. Men feel science will reward cognitive competencies; women focus on self-management. Both genders believe that science programs will reward the competencies they feel they have.

There is a chicken-and-egg circularity concerning the problem of encouraging more women to enter science, engineering, and related fields. These disciplines have not traditionally been perceived as hospitable to women. But simply advertising or promoting a more user-friendly work/study environment in the hope of increasing the number of women career scientists, would be ultimately self-defeating. Similarly, financial incentives or scholarships alone are unlikely to be enough. On the other hand, if there were more practising women scientists and teachers then it would be easier for women students to see the ways in which science can be fulfilling. Consequently, funds and resources dedicated to an improvement in science instruction and curriculum, including new positions for hiring women scientists, would be money well spent.

These results suggest that the following new types of policy initiatives may enhance recruitment into natural science and engineering programs, particularly for talented women students:

1. Public awareness efforts to improve the image of science as practiced. Information about science and science programs should be directed especially to high school teachers, parents, and secondary school students. The information should be realistic, focussing upon the opportunities, challenges and the difficulties of pursuing a career in science. Where possible, legitimate connections between response and care values and actual science practice should be emphasized.

2. Women Scholars should be provided with an honorarium to talk about their experiences and plans with interested high school students. This mentoring might be co-ordinated through the existing Speakers' Bureau Pilot Project and the Canada Scholars Register.

Although both men and women are recruited to science programs, they respond to different calls. This raises the question of whether the educational experiences associated with science education can respond effectively to these differing values and needs.

There is a marked tendency for academic performance to decline between high school and the first few semesters at university for both women and men in science. The magnitude of the drop in grades at Guelph is greater than the drop experienced by Canada Scholars. In the early stages of university more women than men science students experienced grade declines and fewer experienced grade increases. However, the gender differences in academic performance lessen in the latter years. The 'A' women students at entry narrow the gap considerably by the final university semesters. Many of the B+ women at university entry actually achieve an 'A' average late in their undergraduate program.

These achievement patterns are reflected in the response of male and female high achievers to survey questions concerning the positive and negative aspects of university life. University is experienced differently by high achieving men and women in science. Men 'A' students respond much more positively than women 'A' students concerning the following positive aspects of university: academic success; career development; and informal learning. Women high achievers, especially the 'B+' group, on the other hand, respond much more

negatively than men regarding academic stress and personal difficulties as unpleasant aspects of their university experience.

The overall program retention rates for women and men in science are very similar but this does not tell the whole story. First, entering grades have a stronger influence upon program retention for women in science than for men. Second, there are important program behaviour differences between women students entering university with an 'A' high school average and those entering university with a 'B+' high school average. The former tend to transfer to non-CSP disciplines and the latter tend to leave university. Third, the general departure of women high achievers from science disciplines is related not only to their academic performance in university but also to their values, expectations concerning science education, and their career plans.

University level science education does not appear to respond to the response and care values of women in science. Consequently, many high achieving women may experience difficulty in dealing with the (non-cognitive) social and value orientations of science programs. A concern here is that intellectually competent women, more so than their male counterparts, may be leaving science partly in response to pressures created by a lack of fit between their value orientations and expectations and the practices, realities and values of the educational environment.

It is also possible that this lack of fit produces a decline in the academic performance of women early in their university careers. Women in science may need time to construct an appropriate response to various unanticipated and unsatisfying environmental aspects. As the results reveal, a high level of stress is experienced by women in science, particularly those in the 'B+' entering grade category.

Many of the research findings of this project suggest that, in addition to financial incentives such as scholarships, there are non-financial aspects which are related to women top achievers pursuing careers in science, engineering and related programs.

It appears that many women take science programs, not because they wish to pursue a career in the field, but to obtain a prerequisite for a career in another field. It may be the case that rather than a life-long goal or ambition, science is regarded as a means to an end. The career destinations appear to be more practical, applied and more oriented to helping, curing, and healing. In the current research, veterinary medicine and human kinetics represent two examples. At other universities paths from science to medicine and other disciplines may be revealed.

This raises the question about the correspondence between the nature of certain fields or disciplines and the interests of women. There is no doubt that women prefer warm, supportive, and caring work/study environments where there is an opportunity to help others. Science is not normally perceived in this way. It appears that science instruction in particular is not perceived in this way. Yet there is a collective, collaborative and affective component in the way science is practised. The suggestion which emerges from this distinction is that there may be a need for improvements in science teaching and curriculum. A more practical, applied, relevant, hands-on, curriculum; smaller classes; more personal instruction, more women role models; and a more harmonious and co-operative environment are all suggestions that come to mind. Any movement away from rote learning of a myriad of discrete facts and abstract problem solving procedures and towards more creative, broader, and relational thinking is likely to have positive consequences.

These findings lead to the following recommendations to improve program retention for women scholars:

1. Social support initiatives to assist scholars with the important transition from first to second year should be developed.

2. The Mentor Clubs represent one example of the kind of social support necessary and consideration should be given to expanding this initiative so that a Club exists at each university.

3. Funds should be allocated to establish a position whereby a program officer would visit university campuses and meet with groups of scholars to discuss experiences, progress and difficulties. Where warranted individual consultations might occur.

4. A CSP newsletter should be established to keep scholars informed of current issues, including gender issues, and containing a list of persons to contact on campus should problems arise. Mentor Club participants would be likely candidates. Commissioned articles, research abstracts, and letters could share the vicissitudes of majoring in natural science and engineering fields.

5. Scholars, and possibly all women entering science disciplines, should be provided with materials informing them of some of the possible difficulties they may encounter and offering suggestions for dealing with them. This information should be based upon the experiences of students as they complete their programs.

6. Institutions accepting Canada Scholars should be asked to conduct non-renewal interviews with women scholars. Such interviews would be voluntary and could provide important information on why scholars experience difficulty in maintaining their level of academic achievement.

7. A modest, pilot fund for the enhancement of science teaching should be established. New approaches toward classroom and laboratory instruction which emphasize personal, relevant, practical, hands-on, co-operative and creative settings and experiences, would have positive consequences. Projects should be evaluated and science instructors should be made aware of successful and unsuccessful initiatives.

8. More research should be conducted on the relationship between the characteristics of the teaching environment in science and students experiences and achievements.

The findings on academic achievement suggest policy changes which may improve CSP retention rates, particularly for women. Since it is commonplace for 'A' students in high

school to receive lower grades in their first few semesters at university but then to improve thereafter, it may be excessively stringent to require an A average for scholarship renewal from first to the second year. Relaxing this requirement slightly would still ensure excellence but allow for the normal transition and adjustment to university standards and criteria. This may be beneficial for women in particular who exhibit a greater drop in grades in part because of non-cognitive factors such as greater academic stress.

Consideration should be given to developing less stringent renewal criteria. Aspects which could be explored are: renewal with a 'B+' standing at the end of the first year and 'A' thereafter; allowing non-renewed Scholars who subsequently achieve an 'A' standing to be considered for renewal; and similar features.

However, much more than financial matters are involved in gender tracking. More positive outcomes would occur if women entering science disciplines knew what to expect, knew how to manage the transition to university, and had more support in their first year. Similarly, if the educational climates within natural science and engineering fields were more hospitable many more talented women would remain in these disciplines.

References

Association of Universities and Colleges of Canada
1990 **Trends.** Ottawa: Research Policy and Planning with Statistics Canada data.

Dagg, Anne Innis & Patricia J. Thompson
1988 **MisEducation: Women and Canadian Universities.** Toronto: Ontario Institute for Studies in Education.

Ethington, Corinna A. & Lee M. Wolfle
1984 "Sex differences in a causal model of mathematics achievement". **Journal for Research in Mathematics Education.** (15:5) 361-377.

Evers, Frederick T. & Sid. N. Gilbert
For. "Outcomes assessment: how much value does university education add?" **Canadian Journal of Higher Education.**

Fausto-Sterling, Anne
1985 **Myths of Gender: Biological Theories About Women and Men.** New York: Basic Books.

Fennema, Elizabeth & Penelope Peterson
1985 "Autonomous learning behaviour: a possible explanation of gender-related differences in mathematics. In Louise Cherry Wilkinson & Cora B. Marrett (eds.) **Gender Influences in Classroom Interaction.** New York: Academic Press.

Gilbert, Sid & Marion Auger
1988 **Student Finances and University Attrition.** Ottawa: Department of the Secretary of State of Canada.

Gilbert, Sid
1989 "The forgotten purpose and future promise of university education." **Canadian Journal of Community Mental Health,** (Vol. 8, Fall) 103-122.

Gilbert, Sid & Frederick T. Evers
1989 "Accessibility and quality in higher education." **The Service Industries Journal (9 October)** 44-62.

Gilbert, Sid & Frederick T. Evers and Marion Auger
1989 "University attrition differentiated: rates and institutional influences." Paper presented at the Canadian Society for the Study of Higher Education annual meetings, Quebec, Laval University.

Gilligan, Carol
1982 **In a Different Voice: Psychological Theory and Women's Development.** Cambridge, Mass.: Harvard University Press.

Harding, Sandra
1986 **The Science Question in Feminism.** Ithica: Cornell University Press.

Lengermann, Patricia M. & Jill Niebrugge-Brantely
1990 "Feminist sociological theory: the near-future prospects." In George Ritzer (ed.) **Frontiers of Sociological Theory: The New Synthesis.** New York: Columbia University Press.

Maccoby, Eleanor Emmons & Carol Nagy Jacklin
1974 **The Psychology of Sex Differences.** Stanford, Calif.: Stanford University Press.

Tinto, Vincent
1987 **Leaving College: Rethinking the Causes and Cures of Student Attrition.** Chicago: The University of Chicago Press.

Table A4.1.1

Gender Patterns Concerning Basic Value Orientations[1] for Students Entering Science and Non-Science Programs

Category	Gamma Statistics[2]	
	Students	
	Science	Non-Science
Response and Care Orientation		
Relationships with other people	.10	.56
Forming personal attachments with fellow students	.03	.18
Having affection for co-workers, fellow-students	.13	.01
Caring for others	.16	.27
Working in a supportive environment	.32	.38
Harmony in your work/study environment	.20	.08
Making decisions according to a particular context or situation	-.05	-.10
Justice and Rights Orientation		
Competitive situations	.01	-.08
Working/studying on your own	.11	-.11
Evaluating the work of others	-.03	-.06
Taking a leadership role when doing group projects	-.16	.03
Debating or intellectual sparring	.03	-.17
Handling conflict in your work/study environment	-.05	-.04
Using deductive logic	-.05	.08
Making decisions according to abstract rules and principles	-.17	-.07
Other		
Highly structured study/work career path	.11	-.04
Very specialized study/work career path	.11	-.07
Working with concrete facts	.03	-.06

[1]Students were asked: "To what extent do you value the following:" (Item 22 on the Winter CEASE Questionnaire). For each sub-item students could respond to a five-point scale ranging from "a great deal" to "very little".

[2]A positive gamma means that women more than men valued the specific item. A negative gamma means that men more than women valued the specific item. For all gammas on the Gender Pattern tables, sex is the independent variable and the dependent variable is the specific item.

Table A4.1.2

Gender Patterns Concerning Perceptions of Competence or Performance Levels[1] for Students Entering Science and Non-Science Programs

Category	Gamma Statistics[2] Students: Science	Non-Science
Cognitive aspects		
Thinking and reasoning skills	-.30	-.14
Problem-solving skills	-.25	-.12
Quantitative/mathematical skills	-.09	-.01
Decision-making skills	-.08	-.08
Self-Management Aspects		
Planning and organizational skills	.37	.30
Time-management skills	.27	.30
Independence	.01	.02
Interpersonal Aspects		
Communication skills	.05	.07
Supervisory skills	.00	-.06
Interpersonal and social skills	-.05	.15

[1] Students were asked: "How do you rate your level of competence or performance on each of the following:" (Item 17 on the CEASE Winter 1990 Questionnaire). For each sub-item students could respond to a five-point scale ranging from "extremely high" to "very low".

[2] A positive gamma means that women more than men valued the specific item. A negative gamma means that men more than women valued the specific item. For all gammas on the Gender Pattern tables, sex is the independent variable and the dependent variable is the specific item.

Table A4.1.3

Gender Patterns Concerning Abilities Perceived as Important for Success in Students' Chosen Fields of Study[1] for Students entering Science and Non-Science Programs

	Gamma Statistics[2]	
	Students	
Category	Science	Non-Science
Cognitive Aspects		
General academic ability	.12	.22
Ability in mathematics	-.11	.11
Mechanical capabilities	-.08	.05
An enquiring mind	.23	.12
Problem-solving abilities	-.02	.11
Open-mindedness	.14	.32
Self-Management Aspects		
Ability to persevere	.13	.25
Ability to work long hours	.14	.02
Ability to be punctual	.21	.22
Ability to meet deadlines	.22	.20
Planning and organizational ability	.24	.38
Reliability	.17	.38
Desire to work independently	.22	.11
High moral standards	.18	.48
Ability to work independently	.20	.12
Interpersonal Aspects		
Ability to get along with other people	.21	.41
Ability to communicate orally	.07	.43
Ability to communicate in writing	.11	.27
Ability to assert oneself	.17	.26
Ability to help others	.22	.47
Ability to adapt	.12	.27

[1]Students were asked: " In your opinion, how important are the following abilities or capabilities in **your chosen field of study** in order to be successful at the undergraduate level:" (Item 27 on the Winter 1990 CEASE Questionnaire). For each sub-item, students could respond to a five-point scale ranging from "extremely important" to "not at all important".

[2]A positive gamma means that women more than men valued the specific item. A negative gamma means that men more than women valued the specific item. For all gammas on the Gender Pattern tables, sex is the independent variable and the dependent variable is the specific item.

Table A4.1.4

Gender Patterns Concerning the Importance of Factors which Influence Discipline Choice[1] for Students Entering Science and Non-Science Programs

	Gamma Statistics[2]	
	Students	
	Science	Non-Science
Home Influences		
Mother	.18	.26
Father	.15	.18
Other family member	.13	.17
High School Influences		
Friends	-.02	.10
Good marks in subject	.45	.41
High school teachers	.19	.18
Guidance counsellors	.16	.24
Interest in subject matter	.26	.28
Self-Assessment of Abilities		
Cognitive		
Logical abilities	.06	-.01
Mathematical abilities	.03	.09
Interpersonal		
Writing abilities	.29	.16
Communication abilities	.17	.28
Interpersonal abilities	.20	.31
Decision-making abilities	.19	.13
Artistic abilities	.07	.10
Career Experiences		
Summer employment	.00	.15
Full-time employment	-.01	-.03
Perceptions and Expectations		
Expectation of good marks	.37	.18
Continued interest in subject-matter	.24	.21
Future income expectations	.09	-.07
Career objectives	.18	.18
Lifestyle goals	.08	.11
Desire to be self-sufficient	.36	.17
To respond to the needs of others	.27	.46

[1]Students were asked: "We would like to find out how and when educational disciplines and career choices come into focus and what the influencing factors in the final decisions are. Please tell us how important each of the following factors were in choosing your major in your undergraduate program:" (Item 28 on the Winter 1990 CEASE Questionnaire). Students could respond to a five-point scale ranging from "very important" to "not at all important".

[2]A positive gamma means that women more than men valued the specific item. A negative gamma means that men more than women valued the specific item. For all gammas on the Gender Pattern tables, sex is the independent variable and the dependent variable is the specific item.

Table A4.1.5

Gender Patterns Concerning
Attitude Toward Science and Knowledge of Science[1]
for Students Entering Science and Non-Science Programs

	Gamma Statistics[2]	
	Students	
	Science	Non-Science
Science		
Makes collective decision-making more technical and rational	-.07	.02
Increases our standard of living	-.12	-.25
Provides us with control over nature	.05	.00
Is essential for helping other people	.02	.09
Knowledge of Science		
Facilitates consumer choices	.26	.08
Provides information for better decision-making in society	.02	.06
Provides a sense of control of one's life	.00	-.06
Helps to understand the world in which we are living	.07	-.05

[1]Students were asked: "We would like to have your personal opinion on the importance of science in society generally. Please circle your responses for each statement on a five-point scale, from 'strongly agree' to 'strongly disagree':" (Item 20 on the Winter 1990 CEASE Questionnaire).
[2]A positive gamma means that women more than men valued the specific item. A negative gamma means that men more than women valued the specific item. For all gammas on the Gender Pattern tables, sex is the independent variable and the dependent variable is the specific item.

Table A4.1.6

Gender Patterns Concerning Career Aspirations for Students Entering Science and Non-Science Programs

	Gamma Statistics[1]	
	Students	
	Science	Non-Science
Continue Studies[2]		
In current field at the graduate level	.12	.12
Take a professional degree related to major	-.05	.14
Take a professional degree unrelated to major	.01	-.02
Leave University[2]		
But not join the labour force	-.25	-.06
Choose work unrelated to major	-.14	.04
Find a Job in Area of Study		
In industry	.00	-.11
In government	-.06	.19
In education	.06	.23
Combine Family & Career[3]	.13	.07
Intentions First Emerged[4]	.00	-.19

[1]A positive gamma means that women more than men valued the specific item. A negative gamma means that men more than women valued the specific item. For all gammas on the Gender Pattern tables, sex is the independent variable and the dependent variable is the specific item.

[2]Students were asked: "How do you rate the probability that after graduation you will:" (Item 30 on the Winter 1990 CEASE Questionnaire). For each sub-item students could respond to a five-point scale ranging from "very likely" to "not very likely".

[3] Students were asked: "In your selected field of work how difficult would it be for you to combine family and career responsibilities" (Item 33 on the Winter CEASE Questionnaire). Response categories were on a five-point scale, ranging from "very difficult" to "not difficult at all".

[4] Students were asked: "At what point do you feel your intention concerning a specific area of study/ work first began to emerge" (Question 24 on the Winter CEASE Questionnaire). Response categories were indicated either in grades or years.

Table A4.1.7

Gender of Instructors & Role Models in High School[1] for High Achieving Women, by Program

Category	%Science	%Non-Science
Instructors		
Mainly women	8	6
Mainly men	53	43
Equally women & men	39	51
Total=	100	100
N=	(66)	(47)
Role Models		
Mainly women	15	24
Mainly men	39	21
Equally women & men	46	55
Total=	100	100
N=	(61)	(47)

[1]Students were asked if their instructors or role models in high school were "mainly women", "mainly men", or "equally women and men". (Items 25 and 26 on the CEASE Winter 1990 Questionnaire).

Table A4.1.8

Gender Patterns Concerning Positive and Negative Aspects of University[1] for Students Entering Science and Non-Science Programs

	Gamma Statistics[2]	
Category	Science	Non-Science
Positive Aspects of University		
Personal growth	.25	.26
Friendships, social	.08	.19
Academic success	.06	.09
Professors/ Teaching Assistants	-.02	-.01
Course content	.06	.13
Campus environment	-.16	-.05
Formal learning	.04	.36
Career development	-.16	.07
Informal learning	-.11	.09
Negative Aspects of University		
Grades	.05	.06
Academic stress	-.29	-.17
Personal difficulties	-.28	-.22
Course content	.01	.05
Program requirements	.11	.09
Professors/Teaching Assistants	-.16	-.11
Academic administration	.07	.15
Academic counselling	-.03	.00
Financial difficulties	.00	.07
The learning environment	.03	-.08

[1]Students were asked how positive or negative the above aspects of university were. Response categories were a five-point scale, ranging from "extremely" to "not at all". (Items 1, 2, 3, & 4 on the Winter 1990 CEASE Questionnaire).

[2]A positive gamma means that women more than men valued the specific item. A negative gamma means that men more than women valued the specific item. For all gammas on the Gender Pattern tables, sex is the independent variable and the dependent variable is the category item..

Table A4.1.9

Gender Patterns Concerning University Experiences for Students Entering Science and Non-Science Programs

Category	Science		Non-Science	
	%Women	%Men	%Women	%Men
Most Positive Feature[1a]				
Personal growth	58	39	54	51
Most Negative Feature[1b]				
Academic stress	37	23	33	23
Academic administration	21	24	14	22
Financial difficulties	14	19	24	28
Spent on Studies[1c]				
40 + Hrs./week	28	25	10	23
Questions/Comments Understood[1d]				
Yes, definitely	14	19	22	31
Out of Class Contact[1e]				
20 plus	16	20	13	25
Faculty Interaction[1f]				
Extremely helpful	17	12	19	22
Extremely friendly	23	19	25	16
Extremely effective	11	08	10	08
Extremely supportive	14	14	17	17
Satisfaction with Faculty Contact[1g]				
Very satisfied	35	25	33	25
Active in Intermural Sport[1h]				
Not at all	41	28	55	41
Active in Intercollegiate Sport[1h]				
Not at all	91	79	88	77
Participation in University Activities[1i]				
Very often	14	11	11	15
Comfortable with Criticism[1j]				
Very Comfortable	08	04	03	04
Course Content[1k]				
Extremely relevant to career	08	14	12	12
Extremely relevant to personal development	10	09	1a	20
Skills Developed[1k]				
Extremely relevant to career	13	15	23	27
Extremely relevant to personal development	08	09	25	23
Developed Aesthetic Maturity[1l]				
Not at all	18	25	14	14
Professors Expectations Unrelated to Gender[1m]				
Very true	47	57	40	47
Faculty Interaction Unrelated to Gender [1m]				
Very true	45	52	42	42
Do Differently[1n]				
Study harder	19	29	25	31
Better study habits	50	37	33	41
Increase involvement	21	19	37	23
Balance activities	25	26	15	21
Different program	12	14	16	27
Different field of study	24	34	26	28

Table A4.1.9 (Cont.)

Gender Patterns Concerning University Experiences, For Students Entering Science and Non-Science Programsl

Students were asked:

1.a "Which is the most positive feature of university for you:" (Question 2). Response categories were the ten items of question one.

1.b "Which is the most negative feature of university for you" (Question 4). Response categories were the eleven items of question three.

1.c "How much time, on average, do you spend in classes and outside of classes per week on your studies" (Question 5). Response categories were an eight-point range from "less than 10 hrs." to "40 or more hrs.".

1.d "Do you feel your questions and comments were understood when you spoke out in class" (Question 6). Response categories were a five-point scale, ranging from "yes, definitely" to "no, not at all " .

1.e " How much out-of -class contact of f ive minutes or more each have you had with faculty members" (Question 7). Response categories were a six-point range from "none" to "20 or more contacts".

1.f "How do you feel about your out-of-class interaction with faculty members on each of the following dimensions" (Question 8). Response categories were a five-point scale, ranging from "extremely" to "not at all".

1.g "How satisfied or dissatisfied are you with the out-of-class contact you have had with faculty" (Question 9). Response categories were a five-point scale, ranging from "very satisfied" to "very dissatisfied".

1.h "How active are you in intramural and intercollegiate sports" (Question lOa and b). Response categories were a five-point scale, ranging from "extremely" to "not at all".

1.i "How often in your last year would you say you participated in university activities" (Question 11). Response categories were a five-point scale, ranging from "very often" to "never".

1.j "How comfortable are you when your work is verbally criticised" (Question 12) . Response categories were a five-point scale, ranging from "very comfortable" to "very uncomfortable".

1.k "Would you say that the content covered in your courses and the skills developed by them was/were, on balance, relevant for your future career success, and your overall personal development" (Question 13a, 13b, 14a, and 14b). Response categories were a five-point scale, ranging from "extremely" to "not at all" .

1.l "How much would you say you have developed aesthetic maturity as a result of your education at the University of Guelph" (Question 15h). Response categories were a five-point scale, ranging from "greatly" to "not at all".

1.m "In your opinion which of the following statements were more or less true: a. academic expectations of professors were unrelated to my gender; b. interaction with faculty was unrelated to my gender" (Question 21a, and 21b). Response categories were a five-point scale, ranging from "very true" to "not at all true".

1.n "If you could relive your four years at university what, if anything would you do differently" (Question 38). The first four items represent first choice responses; the final two items represent last choice responses.

Table A4.2.1

Gender Patterns Concerning the Importance of Factors which Influence Discipline Choice[1] for All Students, and A, B+, and Other[2] Science Students

	Gamma Statistics[3]			
		Science Students		
Category	All Students	A	B+	Other
Home Influences				
Mother	.23	.13	.28	.12
Father	.15	.13	.15	.12
Other family member	.17	.02	.18	.14
High School Influences				
Friends	.08	.03	.03	.11
Good marks in subject	.37	.51	.42	.36
High school teachers	.18	.41	.30	.01
Guidance counsellors	.21	.13	.11	.22
Interest in subject matter	.22	.33	.43	.10
Self-Assessment of Abilities				
Cognitive				
Logical abilities	.01	-.11	.04	.07
Mathematical abilities	-.04	.18	-.07	-.10
Interpersonal				
Writing abilities	.27	.37	.39	.15
Communication abilities	.29	.18	.24	.09
Interpersonal abilities	.34	.22	.14	.18
Decision-making abilities	.19	.14	.28	.17
Artistic abilities	.15	.32	.07	-.03
Career Experiences				
Summer employment	.05	-.22	-.08	.08
Full-time employment	.00	-.09	-.14	.00
Perceptions and Expectations				
Expectation of good marks	.29	.19	-.08	.34
Continued interest in subject-matter	.23	-.04	.30	.37
Future income expectations	.04	.02	.19	.15
Career objectives	.20	-.03	.26	.28
Lifestyle goals	.13	-.06	.12	.16
Desire to be self-sufficient	.27	.40	.17	.37
To respond to the needs of others	.42	.28	.21	.28

[1]Students were asked: "We would like to find out how and when educational disciplines and career choices come into focus and what the influencing factors in the final decisions are. Please tell us how important each of the following factors were in choosing your major in your undergraduate program:" (Item 28 on the Winter 1990 CEASE Questionnaire). Students could respond to a five-point scale ranging from "very important" to "not at all important".

[2]This is high school grade at time of entry into university in Fall 1986. 'A' refers to students with entry entry grades of 80% or higher; 'B+' refers to those with entry grades between 75% and 79%; Other' refers to those with Fall 1986 entry marks between 50% and 74%.

[3]A positive gamma means that women more than men valued the specific item. A negative gamma means that men more than women valued the specific item. For all gammas on the Gender Pattern tables, sex is the independent variable and the dependent variable is the category item.

Table A4.2.2

Gender Relationships Concerning Abilities Perceived as Important for Success in Chosen Fields of Study[1] for All Students, and A, B+, and Other[2] Science Students

	Gamma Statistics[3]			
		Science Students		
Category	All Students	A	B+	Other
Cognitive Aspects				
General academic ability	.14	-.11	.37	.13
Ability in mathematics	-.11	-.09	-.01	-.20
Mechanical capabilities	-.07	-.07	-.08	-.15
An enquiring mind	.18	.16	.18	.26
Problem-solving abilities	.02	-.14	-.09	-.02
Open-mindedness	.28	-.05	-.04	.30
Self-Management Aspects				
Ability to persevere	.16	.15	-.16	.21
Ability to work long hours	.08	.22	.04	.07
Ability to be punctual	.26	.11	.19	.20
Ability to meet deadlines	.25	.17	.18	.25
Planning and organizational ability	.34	-.01	.36	.35
Reliability	.31	.17	-.11	.25
Desire to work independently	.17	.29	.33	.18
High moral standards	.34	.03	.14	.21
Ability to work independently	.16	.08	.14	.23
Interpersonal Aspects				
Ability to get along with other people	.36	.15	-.04	.30
Ability to communicate orally	.32	-.11	-.17	.19
Ability to communicate in writing	.25	.05	-.05	.17
Ability to assert oneself	.27	.08	.07	.26
Ability to help others	.38	.11	.20	.23
Ability to adapt	.22	.06	-.16	.30

[1]Students were asked: " In your opinion, how important are the following abilities or capabilities in **your chosen field of study** in order to be successful at the undergraduate level:" (Question 27 on the Winter 1990 CEASE Questionnaire). For each sub-item, students could respond to a five-point scale ranging from "extremely important" to "not at all important".

[2]This is high school grade at time of entry into university in Fall 1986. 'A' refers to students with entry entry grades of 80% or higher; 'B+' refers to those with entry grades between 75% and 79%; Other' refers to those with Fall 1986 entry marks between 50% and 74%.

[3]A positive gamma means that women more than men valued the specific item. A negative gamma means that men more than women valued the specific item. For all gammas on the Gender Pattern tables, sex is the independent variable and the dependent variable is the category item..

Table A4.2.3

Gender Patterns Concerning Perceptions of Competence or Performance Levels[1] for All Students, and A, B+, and Other[2] Science Students

	Gamma Statistics[3]			
		Science Students		
Category	All Students	A	B+	Other
Cognitive aspects				
Thinking and reasoning skills	-.23	-.46	-.35	-.20
Problem-solving skills	-.20	-.30	-.58	-.15
Quantitative/mathematical skills	-.16	-.09	-.14	-.19
Decision-making skills	-.05	-.19	-.18	.09
Self-Management Aspects				
Planning and organizational skills	.35	.19	.59	.38
Time-management skills	.28	.24	.41	.21
Independence	.04	-.06	-.29	.11
Interpersonal Aspects				
Communication skills	.12	-.28	.08	.19
Supervisory skills	.01	-.09	-.01	.05
Interpersonal and social skills	.11	-.31	-.10	.10

[1]Students were asked: "How do you rate your level of competence or performance on each of the following:" (Question 17 on the CEASE Winter 1990 Questionnaire). For each sub-item students could respond to a five-point scale ranging from "extremely high" to "very low".

[2]This is high school grade at time of entry into university in Fall 1986. 'A' refers to students with entry entry grades of 80% or higher; 'B+' refers to those with entry grades between 75% and 79%; Other' refers to those with Fall 1986 entry marks between 50% and 74%.

[3]A positive gamma means that women more than men valued the specific item. A negative gamma means that men more than women valued the specific item. For all gammas on the Gender Pattern tables, sex is the independent variable and the dependent variable is the category item.

Table A4.2.4

Gender Patterns Concerning Basic Value Orientations to Self and Others[1] for All Students, and A, B+, and Other[2] Science Students

	Gamma Statistics[3]			
		Science Students		
Category	All Students	A	B+	Other
Response and Care Orientation				
Relationships with other people	.34	.08	-.21	.18
Forming personal attachments with fellow students	.13	-.04	.00	.15
Having affection for co-workers, fellow-students	.08	.25	-15	.19
Caring for others	.26	.27	.17	.16
Working in a supportive environment	.38	.51	.02	.36
Harmony in your work/study environment	.15	.38	.22	.04
Making decisions according to a particular context or situation	-.05	-.09	-.22	.04
Working as part of a team	.05	.07	.28	.00
Justice and Rights Orientation				
Competitive situations	-.01	-.02	.00	.09
Working/studying on your own	.01	.26	-.04	.04
Evaluating the work of others	-.04	-.01	-.19	.01
Taking a leadership role when doing group projects	-.05	-.09	-.07	.04
Debating or intellectual sparring	-.07	.00	.32	.10
Handling conflict in your work/study environment	-.03	-.09	.12	.14
Using deductive logic	-.01	.18	-.04	.11
Making Decisions according to abstract rules and principles	-.13	-.08	.21	-.33
Other				
Highly structured study/work career path	.05	.05	.09	.16
Very specialized study/work career path	.01	.17	-.20	.08
Working with concrete facts	-.02	.06	.23	-.04

[1]Students were asked: "To what extent do you value the following:" (Item 22 on the Winter CEASE Questionnaire). For each sub-item students could respond to a five-point scale ranging from "a great deal" to "very little".

[2]This is high school grade at time of entry into university in Fall 1986. 'A' refers to students with entry entry grades of 80% or higher; 'B+' refers to those with entry grades between 75% and 79%; Other' refers to those with Fall 1986 entry marks between 50% and 74%.

[3]A positive gamma means that women more than men valued the specific item. A negative gamma means that men more than women valued the specific item. For all gammas on the Gender Pattern tables, sex is the independent variable and the dependent variable is the category item..

Table A4.2.5

Gender Patterns Concerning
Attitude Toward Science and Knowledge of Science[1]
for All Students, and A, B+, and Other[2] Science Students

	Gamma Statistics[3]			
		Science Students		
Category	All Students	A	B+	Other
Science				
Makes collective decision-making more technical and rational	-.11	-.07	-.14	-.09
Increases our standard of living	-.21	-.22	-.11	-.08
Provides us with control over nature	.01	-.02	-.04	.12
Is essential for helping other people	.01	-.08	-.10	.12
Knowledge of Science				
Facilitates consumer choices	.14	.19	.25	.28
Provides information for better decision-making in society	-.02	-.13	.04	.13
Provides a sense of control of one's life	-.03	-.10	.00	.10
Helps to understand the world in which we are living	-.04	-.23	.02	.27

[1]Students were asked: "We would like to have your personal opinion on the importance of science in society generally. Please circle your responses for each statement on a five-point scale, from 'strongly agree' to 'strongly disagree':" (Item 20 on the Winter 1990 CEASE Questionnaire).

[2]This is high school grade at time of entry into university in Fall 1986. 'A' refers to students with entry entry grades of 80% or higher; 'B+' refers to those with entry grades between 75% and 79%; Other' refers to those with Fall 1986 entry marks between 50% and 74%.

[3]A positive gamma means that women more than men valued the specific item. A negative gamma means that men more than women valued the specific item. For all gammas on the Gender Pattern tables, sex is the independent variable and the dependent variable is the category item..

Table A4.2.6

Gender Patterns Concerning Career Aspirations for All Students, and A,B+, and Other[1] Science Students

Category	Gamma Statistics[2]			
		Science Students		
	All Students	A	B+	Other
Continue Studies[3]				
In current field at the graduate level	.10	.23	.07	.09
Take a professional degree related to major	.06	-.09	-.08	.01
Take a professional degree unrelated to major	.00	.12	.07	-.05
Leave University[3]				
But not join the labour force	-.15	-.14	-.16	-.29
Choose work unrelated to major	-.04	.07	.08	-.35
Find a Job in Area of Study				
In industry	-.03	-.22	.21	.06
In government	.05	.15	-.10	.08
In education	.17	-.13	.07	.15
Combine Family & Career[4]	.13	.17	.06	.13
Intentions first emerged[5]	-.05	.12	-.26	.01

[1]This is high school grade at time of entry into university in Fall 1986. 'A' refers to students with entry entry grades of 80% or higher; 'B+' refers to those with entry grades between 75% and 79%; Other' refers to those with Fall 1986 entry marks between 50% and 74%.

[2]A positive gamma means that women more than men valued the specific item. A negative gamma means that men more than women valued the specific item. For all gammas on the Gender Pattern tables, sex is the independent variable and the dependent variable is the category item..

[3]Students were asked: "How do you rate the probability that after graduation you will:" (Item 30 on the Winter 1990 CEASE Questionnaire). For each sub-item students could respond to a five-point scale ranging from "very likely" to "not very likely".

[4]Students were asked: "In your selected field of work how difficult would it be for you to combine family and career responsibilities" (Item 33 on the Winter CEASE Questionnaire). Response categories were on a five-point scale, ranging from "very difficult" to "not difficult at all".

[5]Students were asked: "At what point do you feel your intention concerning a specific area of study/ work first began to emerge" (Question 24 on the Winter CEASE Questionnaire). Response categories were indicated either in grades or years.

Table A4.2.7

Gender of Instructors & Role Models in High School[1] for All Students & Science High Achievers[2] by Gender

Category	All Students		Science High Achievers	
	%Women	%Men	%Women	%Men
Instructors				
Mainly women	7	2	8	2
Mainly men	42	50	53	63
Equally women & men	51	48	39	35
N=	(492)	(294)	(66)	(43)
Role Models				
Mainly women	20	3	15	0
Mainly men	31	67	39	80
Equally women & men	49	30	46	20
N=	(482)	(278)	(61)	(40)

[1]Students were asked if their instructors or role models in high school were "mainly women", "mainly men", or "equally women and men".

[2]This refers to high school grade at time of entry into university in Fall 1986. In this table, 'high achievers' refers to students with entry entry grades of 75% or higher.

Table A4.2.8

Gender Patterns Concerning Positive and Negative Aspects of University[1] for All Students, A, B+, and Other[2] Science Students

Category	Gamma Statistics[3]			
		Science Students		
	All Students	A	B+	Other
Positive Aspects of University				
Personal growth	.29	.12	.23	.30
Friendships, social	.14	-.09	-.08	.27
Academic success	.11	-.26	-.10	.18
Professors/ Teaching Assistants	.00	-.12	.11	-.08
Course content	.08	-.09	.14	.05
Campus environment	-.07	-.20	-.44	.01
Formal learning	.21	-.02	.00	.10
Career development	-.03	-.40	-.24	-.05
Informal learning	.03	-.43	-.27	.17
Negative Aspects of University				
Grades	.09	-.15	-.07	.15
Academic stress	-.23	-.35	-.51	-.12
Personal difficulties	-.26	-.32	-.55	-.08
Course content	.00	-.08	-.09	.10
Program requirements	.12	-.02	.00	.15
Professors/Teaching Assistants	-.13	-.07	.03	-.26
Academic administration	.06	.07	.07	-.16
Academic counselling	.00	.03	.04	-.06
Financial difficulties	.00	-.12	.07	.08
The learning environment	-.02	-.06	-.09	.13

[1]Students were asked how positive or negative the above aspects of university were. Response categories were a five-point scale, ranging from "extremely" to "not at all". (Items 1, 2, 3, & 4 on the Winter 1990 CEASE Questionnaire).

[2]This is high school grade at time of entry into university in Fall 1986. 'A' refers to students with entry entry grades of 80% or higher; 'B+' refers to those with entry grades between 75% and 79%; Other' refers to those with Fall 1986 entry marks between 50% and 74%.

[3]A positive gamma means that women more than men valued the specific item. A negative gamma means that men more than women valued the specific item. For all gammas on the Gender Pattern tables, sex is the independent variable and the dependent variable is the category item..

Table A4.2.9

Gender Patterns Concerning University Experiences, For All Students, High Achieving Science Students, and B+ Women Science Students

Category	All Students		High Achieving Science Students		B+
	%Women	%Men	%Women	% Men	WIS
Most Positive Feature[1a]					
Personal growth	56	44	54	44	69
Most Negative Feature[1b]					
Academic stress	34	23	36	32	53
Academic administration	17	23	25	32	16
Financial difficulties	20	22	17	11	06
Spent on Studies[1c]					
40 + Hrs./week	17	24	32	44	26
Questions/Comments Understood[1d]					
Yes, definitely	19	24	9	23	19
Out of Class Contact[1e]					
20 plus	15	22	20	13	14
Faculty Interaction[1f]					
Extremely helpful	18	15	16	11	18
Extremely friendly	24	18	26	20	14
Extremely effective	10	8	11	5	8
Extremely supportive	16	15	16	11	12
Satisfaction with Faculty Contact[1g]					
Very satisfied	34	25	41	31	25
Active in Intermural Sport[1h]					
Not at all	50	33	41	29	49
Active in Intercollegiate Sport[ih]					
Not at all	89	78	91	80	92
Participation in University Activities[1i]					
Very often	13	12	15	11	14
Comfortable with Criticism[1j]					
Very Comfortable	5	4	8	7	8
Course Content[1k]					
Extremely relevant to career	11	13	11	22	8
Extremely relevant to personal development	15	13	5	9	14
Skills Developed[1k]					
Extremely relevant to career	19	19	17	27	10
Extremely relevant to personal development	19	15	8	18	6
Developed Aesthetic Maturity[11]					
Not at all	12	20	18	31	18
Professors Expectations Unrelated to Gender[1m]					
Very true	43	53	51	65	40
Faculty Interaction Unrelated to Gender [1m]					
Very true	44	48	46	57	38
Do Differently[1n]					
Study harder	22	30	6	14	24
Better study habits	40	39	53	39	52
Increase involvement	31	21	35	33	10
Balance activities	19	24	28	29	31
Different program	14	19	12	27	09
Different field of study	25	32	21	35	28

Table A4.2.9 (Cont.)

Gender Patterns Concerning University Experiences, For All Students, High Achieving Science Students, and B+ Women Science Students

Students were asked:

1.a "Which is the most positive feature of university for you:" (Question 2). Response categories were the ten items of question one.

1.b "Which is the most negative feature of university for you" (Question 4). Response categories were the eleven items of question three.

1.c "How much time, on average, do you spend in classes and outside of classes per week on your studies" (Question 5). Response categories were an eight-point range from "less than 10 hrs." to "40 or more hrs.".

1.d "Do you feel your questions and comments were understood when you spoke out in class" (Question 6). Response categories were a five-point scale, ranging from "yes, definitely." to "no, not at all " .

1.e " How much out-of -class contact of f ive minutes or more each have you had with faculty members" (Question 7). Response categories were a six-point range from "none" to "20 or more contacts".

1.f "How do you feel about your out-of-class interaction with faculty members on each of the following dimensions" (Question 8). Response categories were a five-point scale, ranging from "extremely" to "not at all".

1.g "How satisfied or dissatisfied are you with the out-of-class contact you have had with faculty" (Question 9). Response categories were a five-point scale, ranging from "very satisfied" to "very dissatisfied".

1.h "How active are you in intramural and intercollegiate sports" (Question lOa and b). Response categories were a five-point scale, ranging from "extremely" to "not at all".

1.i "How often in your last year would you say you participated in university activities" (Question 11). Response categories were a five-point scale, ranging from "very often" to "never".

1.j "How comfortable are you when your work is verbally criticised" (Question 12) . Response categories were a five-point scale, ranging from "very comfortable" to "very uncomfortable".

1.k "Would you say that the content covered in your courses and the skills developed by them was/were, on balance, relevant for your future career success, and your overall personal development" (Question 13a, 13b, 14a, and 14b). Response categories were a five-point scale, ranging from "extremely" to "not at all" .

1.l "How much would you say you have developed aesthetic maturity as a result of your education at the University of Guelph" (Question 15h). Response categories were a five-point scale, ranging from "greatly" to "not at all".

1.m "In your opinion which of the following statements were more or less true: a. academic expectations of professors were unrelated to my gender; b. interaction with faculty was unrelated to my gender" (Question 21a, and 21b). Response categories were a five-point scale, ranging from "very true" to "not at all true".

1.n "If you could relive your four years at university what, if anything would you do differently" (Question 38). The first four items represent first choice responses; the final two items represent last choice responses.

Table A4.2.9 (Cont.)

Gender Patterns Concerning University Experiences, For All Students, High Achieving Science Students, and B+ Women Science Students

Students were asked:

1.a "Which is the most positive feature of university for you:" (Question 2). Response categories were the ten items of question one.

1.b "Which is the most negative feature of university for you" (Question 4). Response categories were the eleven items of question three.

1.c "How much time, on average, do you spend in classes and outside of classes per week on your studies" (Question 5). Response categories were an eight-point range from "less than 10 hrs." to "40 or more hrs.".

1.d "Do you feel your questions and comments were understood when you spoke out in class" (Question 6). Response categories were a five-point scale, ranging from "yes, definitely" to "no, not at all " .

1.e " How much out-of -class contact of f ive minutes or more each have you had with faculty members" (Question 7). Response categories were a six-point range from "none" to "20 or more contacts".

1.f "How do you feel about your out-of-class interaction with faculty members on each of the following dimensions" (Question 8). Response categories were a five-point scale, ranging from "extremely" to "not at all".

1.g "How satisfied or dissatisfied are you with the out-of-class contact you have had with faculty" (Question 9). Response categories were a five-point scale, ranging from "very satisfied" to "very dissatisfied".

1.h "How active are you in intramural and intercollegiate sports" (Question lOa and b). Response categories were a five-point scale, ranging from "extremely" to "not at all".

1.i "How often in your last year would you say you participated in university activities" (Question 11). Response categories were a five-point scale, ranging from "very often" to "never".

1.j "How comfortable are you when your work is verbally criticised" (Question 12) . Response categories were a five-point scale, ranging from "very comfortable" to "very uncomfortable".

1.k "Would you say that the content covered in your courses and the skills developed by them was/were, on balance, relevant for your future career success, and your overall personal development" (Question 13a, 13b, 14a, and 14b). Response categories were a five-point scale, ranging from "extremely" to "not at all" .

1.l "How much would you say you have developed aesthetic maturity as a result of your education at the University of Guelph" (Question 15h). Response categories were a five-point scale, ranging from "greatly" to "not at all".

1.m "In your opinion which of the following statements were more or less true: a. academic expectations of professors were unrelated to my gender; b. interaction with faculty was unrelated to my gender" (Question 21a, and 21b). Response categories were a five-point scale, ranging from "very true" to "not at all true".

1.n "If you could relive your four years at university what, if anything would you do differently" (Question 38). The first four items represent first choice responses; the final two items represent last choice responses.

Table A4.4.1.1

Associations Between Basic Value Orientations to Self and Others[1] and Program Behaviour[2] for All Entering Students and All Entering Science Students

Category	Gamma Statistics[3] Students All	Science
Response and Care Orientation		
Relationships with other people	.06	.08
Forming personal attachments with fellow students	.11	.09
Having affection for co-workers, fellow-students	-.04	-.11
Caring for others	.04	-.01
Working in a supportive environment	-.12	-.02
Harmony in your work/study environment	.11	.21
Making decisions according to a particular context or situation	-.16	-.29
Working as part of a team	.04	.02
Justice and Rights Orientation		
Competitive situations	.09	.17
Working/studying on your own	-.06	-.06
Evaluating the work of others	-.10	-.15
Taking a leadership role when doing group projects	.18	.08
Debating or intellectual sparring	.10	.12
Handling conflict in your work/study environment	.10	.14
Using deductive logic	-.03	.00
Making Decisions according to abstract rules and principles	.09	.14
Other		
Highly structured study/work career path	.12	.11
Very specialized study/work career path	.03	.09
Working with concrete facts	-.03	-.06

[1]Students were asked: "To what extent do you value the following:" (Item 22 on the Winter CEASE Questionnaire). For each sub-item students could respond to a five-point scale ranging from "a great deal" to "very little".

[2]Students were classified as Leavers, Changers, or Persisters depending on their change in program status between Fall 1986 and Winter 1990.

[3]A positive gamma means that Persisters more than Leavers or Changers valued the specific item. A negative gamma means that Leavers and Changers more than Persisters valued the specific item. For all gammas the independent variable is the specific item and the dependent variable is program behaviour.

Table A4.4.2.1

Associations Between Perceptions of Competence or Performance Levels[1] and Program Behaviour[2] for All Entering Students and All Entering Science Students

	Gamma Statistics[3]	
	Students	
Category	All	Science
Cognitive aspects		
Thinking and reasoning skills	-.19	-.20
Problem-solving skills	-.19	-.22
Quantitative/mathematical skills	-.28	-.06
Decision-making skills	-.05	-.09
Self-Management Aspects		
Planning and organizational skills	.07	-.11
Time-management skills	-.05	-.18
Independence	.01	-.08
Interpersonal Aspects		
Communication skills	.03	-.18
Supervisory skills	-.04	-.14
Interpersonal and social skills	-.02	-.21

[1]Students were asked: "How do you rate your level of competence or performance on each of the following:" (Question 17 on the CEASE Winter 1990 Questionnaire). For each sub-item students could respond to a five-point scale ranging from "extremely high" to "very low".

[2]Students were classified as Leavers, Changers, or Persisters depending on their change in program status between Fall 1986 and Winter 1990.

[3] A positive gamma means that Persisters more than Leavers or Changers valued the specific item. A negative gamma means that Leavers and Changers more than Persisters valued the specific item. For all gammas the independent variable is the specific item and the dependent variable is program behaviour.

Table A4.4.3.1

Associations Between Abilities Perceived as Important for Success in Chosen Fields of Study[1] and Program Behaviour[2] for All Entering Students and All Entering Science Students

Category	Gamma Statistics[3] Students All	Science
Cognitive Aspects		
General academic ability	-.12	-.13
Ability in mathematics	.01	.43
Mechanical capabilities	-.14	-.04
An enquiring mind	-.01	-.05
Problem-solving abilities	-.16	-.14
Open-mindedness	.02	-.27
Self-Management Aspects		
Ability to persevere	-.13	-.17
Ability to work long hours	-.16	-.23
Ability to be punctual	.10	-.08
Ability to meet deadlines	.15	-.04
Planning and organizational ability	-.04	-.26
Reliability	.03	-.16
Desire to work independently	.00	-.03
High moral standards	-.12	-.29
Ability to work independently	-.05	-.15
Interpersonal Aspects		
Ability to get along with other people	-.01	-.36
Ability to communicate orally	-.03	-.53
Ability to communicate in writing	.10	-.22
Ability to assert oneself	.07	-.25
Ability to help others	.08	-.18
Ability to adapt	.08	-.08

[1]Students were asked: " In your opinion, how important are the following abilities or capabilities in **your chosen field of study** in order to be successful at the undergraduate level:" (Question 27 on the Winter 1990 CEASE Questionnaire). For each sub-item, students could respond to a five-point scale ranging from "extremely important" to "not at all important".

[2]Students were classified as Leavers, Changers, or Persisters depending on their change in program status between Fall 1986 and Winter 1990.

[3]A positive gamma means that Persisters more than Leavers or Changers valued the specific item. A negative gamma means that Leavers and Changers more than Persisters valued the specific item. For all gammas the independent variable is the specific item and the dependent variable is program behaviour.

Table A4.4.4.1

Associations Between the Importance of Factors which Influence Discipline Choice[1] and Program Behaviour[2] for All Entering Students and All Entering Science Students

	Gamma Statistics[3]	
	Students	
	All	Science
Home Influences		
Mother	-.10	-.14
Father	-.14	-.13
Other family member	-.07	-.08
High School Influences		
Friends	.07	-.01
Good marks in subject	-.11	-.05
High school teachers	.03	.06
Guidance counsellors	.08	.10
Interest in subject matter	-.03	.10
Self-Assessment of Abilities		
Cognitive		
Logical abilities	-.32	-.36
Mathematical abilities	-.08	.21
Interpersonal		
Writing abilities	-.05	-.28
Communication abilities	-.06	-.38
Interpersonal abilities	-.03	-.35
Decision-making abilities	.02	-.07
Artistic abilities	.12	-.10
Career Experiences		
Summer employment	-.06	-.07
Full-time employment	.08	.07
Perceptions and Expectations		
Expectation of good marks	-.21	-.29
Continued interest in subject-matter	-.18	-.13
Future income expectations	.28	-.27
Career objectives	.00	.02
Lifestyle goals	.10	.03
Desire to be self-sufficient	.00	.04
To respond to the needs of others	-.03	-.17

[1]Students were asked: "We would like to find out how and when educational disciplines and career choices come into focus and what the influencing factors in the final decisions are. Please tell us how important each of the following factors were in choosing your major in your undergraduate program:" (Item 28 on the Winter 1990 CEASE Questionnaire). Students could respond to a five-point scale ranging from "very important" to "not at all important".

[2]Students were classified as Leavers, Changers, or Persisters depending on their change in program status between Fall 1986 and Winter 1990.

[3]A positive gamma means that Persisters more than Leavers or Changers valued the specific item. A negative gamma means that Leavers and Changers more than Persisters valued the specific item. For all gammas the independent variable is the specific item and the dependent variable is program behaviour.

APPENDIX 7.2

The Winter 1990 Survey

UNIVERSITY of GUELPH

STUDENTS' EXPERIENCES AND OUTCOMES

WINTER 1990

- ✓ What factors influenced your choice of program?
- ✓ How satisfied or dissatisfied are you with your education?
- ✓ What skills and abilities have you acquired?

EDUCATIONAL OUTCOMES

Winter 1990

Section 1 Experiences

Thank you for agreeing to fill out this questionnaire. We would like to get some idea of your experiences at the University of Guelph and some idea of the various outcomes these have produced. Please circle or check (√) your answer, as appropriate.

1. Please indicate how positive the following aspects of university were for you:

	Extremely positive	Very positive	Somewhat positive	Barely positive	Not at all positive
A. Personal growth	1	2	3	4	5
B. Friendships, social life	1	2	3	4	5
C. Academic success	1	2	3	4	5
D. Professors or teaching assistants	1	2	3	4	5
E. Course content	1	2	3	4	5
F. Campus environment	1	2	3	4	5
G. Formal learning	1	2	3	4	5
H. Career development	1	2	3	4	5
I. Informal learning	1	2	3	4	5
J. Other (please specify)	1	2	3	4	5

2. Which one of the above aspects represents the most positive feature of university for you? (Please circle the one which applies.)

A B C D E F G H I J

3. Please indicate how negative the following aspects of university were for you:

	Extremely negative	Very negative	Somewhat negative	Barely negative	Not at all negative
A. Grades	1	2	3	4	5
B. Academic stress	1	2	3	4	5
C. Personal difficulties	1	2	3	4	5
D. Course content	1	2	3	4	5
E. Program requirements	1	2	3	4	5
F. Professors or teaching assistants	1	2	3	4	5
G. Academic administration	1	2	3	4	5
H. Academic counselling	1	2	3	4	5
I. Financial difficulties	1	2	3	4	5
J. The learning environment	1	2	3	4	5
K. Other (please specify)	1	2	3	4	5

4. Which one of the above aspects represents the most negative feature of university for you? (Please circle the one which applies.)

A B C D E F G H I J K

5. How much time, on average, do you spend in classes and outside of classes **per week** on your studies?

1. less than 10 hours	5. 25 - 29 hours
2. 10 - 14 hours	6. 30 - 34 hours
3. 15 - 19 hours	7 35 - 40 hours
4. 20 - 24 hours	8. 40 or more hours

6. Do you feel your questions and comments were understood when you spoke out in class?

1. Yes, definitely
2. Yes, mainly
3. Somewhat
4. No, hardly at all
5. No, not at all

7. How much out-of-class contact of five minutes or more each have you had with faculty members over the course of last year?

1. None
2. 1 - 5 contacts
3. 6 - 10 contacts
4. 11 - 15 contacts
5. 16 - 20 contacts
6. 20 or more contacts

8. On average, how did you feel about your out-of-class interaction with faculty members on each of the following dimensions? Please check (√) your response.

It was	1 Extremely	2 Very	3 Somewhat	4 Barely	5 Not at all
a. Helpful					
b. Friendly					
c. Effective					
d. Supportive					

9. How satisfied or dissatisfied are you with the out-of-class contact you have had with faculty?

very satisfied	somewhat satisfied	neither satisfied nor dissatisfied	somewhat dissatisfied	very dissatisfied
☐1	☐2	☐3	☐4	☐5

10a. How active are you in intramural sports?

1. Extremely
2. Very
3. Somewhat
4. Barely
5. Not at all

10b. How active are you in inter-collegiate sports?

1. Extremely
2. Very
3. Somewhat
4. Barely
5. Not at all

11. How often in your last year would you say you participated in university activities such as social events, student politics, symposiums, concerts, etc.?

1. very often
2. often
3. occasionally
4. seldom
5. never

12. How comfortable are you when your work is verbally criticised?

Very comfortable ↓-------↓-------↓-------↓-------↓ Very uncomfortable
1 2 3 4 5

Section 2 Specific Outcomes

13. Would you say that the content covered in your courses was, on balance, relevant for:

your future career success?	your overall personal development?
1. extremely	1. extremely
2. very	2. very
3. somewhat	3. somewhat
4. not at all	4. not at all

14. Would you say that the skills developed by your courses were, on balance, important for:

your future career success?	your overall personal development?
1. extremely	1. extremely
2. very	2. very
3. somewhat	3. somewhat
4. not at all	4. not at all

15. Below is a set of desired characteristics of educated graduates, used in part to guide educators in their development of courses and programs. How much would you say you have developed these characteristics as a result of your education at the University of Guelph?

	greatly	very much	somewhat	hardly	not at all
A. Literacy: reading skills	1	2	3	4	5
writing skills	1	2	3	4	5
oral communication skills	1	2	3	4	5
B. Numeracy: quantitative or computational skills	1	2	3	4	5
C. Sense of historical development/historical consciousness	1	2	3	4	5
D. Independence of thought	1	2	3	4	5
E. Desire to continue learning	1	2	3	4	5
F. Creativity	1	2	3	4	5
G. Global understanding: a sense of wider international and cultural contexts	1	2	3	4	5
H. Moral maturity: an understanding of moral and ethical choices	1	2	3	4	5
I. Aesthetic maturity: acquaintance with literature and the arts	1	2	3	4	5
J. Understanding of forms of inquiry: an appreciation of science and other methods of inquiry and their limitations	1	2	3	4	5
H. Depth and breath of understanding: substantive in depth knowledge of a field of study	1	2	3	4	5

16. Overall, to what degree do you attribute your marks to the following sources? Please estimate the various degree of contribution for each aspect and ensure that the percentages add up to 100%.

Effort	Ability	Luck	Total
.... %	.... %	.... %	100 %

17. How do you rate your level of competence or performance on each of the following:

	Extremely high competence	very high competence	some competence	little competence	very low competence
A. Thinking and reasoning skills	1	2	3	4	5
B. Problem solving skills	1	2	3	4	5
C. Decision making skills	1	2	3	4	5
D. Planning and organizing skills	1	2	3	4	5
E. Time management skills	1	2	3	4	5
F. Communication skills	1	2	3	4	5
G. Interpersonal and social skills	1	2	3	4	5
H. Quantitative/mathematical skills	1	2	3	4	5
I. Independence	1	2	3	4	5
J. Supervisory skills	1	2	3	4	5

18. The levels of competence you have specified above may have resulted from formal or informal university structures and procedures, external (or outside university) structures and procedures or maturation. For each dimension please indicate the "most important" influence (1) and the "least important" influence (4).

	University		Outside University	Maturation
	Formal	Informal		
A. Thinking and reasoning skills				
B. Problem solving skills				
C. Decision making skills				
D. Planning and organizing skills				
E. Time management skills				
F. Communication skills				
G. Interpersonal and social skills				
H. Quantitative/mathematical skills				
I. Independence				
J. Supervisory skills				

1 = most important

4 = least important

19. How much has your university experience contributed to your personal development in the following areas?

	greatly	very much	somewhat	hardly	not at all
A. Self-confidence	1	2	3	4	5
B. Motivation	1	2	3	4	5
C. Ability to handle stress	1	2	3	4	5
D. Ability to deal with conflict	1	2	3	4	5
E. Ability to understand others	1	2	3	4	5
F. Responsibility	1	2	3	4	5
G. Social skills	1	2	3	4	5
H. Social and political awareness	1	2	3	4	5
I. Concern for others	1	2	3	4	5
J. Caring for others	1	2	3	4	5
K. Ability to establish relationships	1	2	3	4	5

Section 3 Opinions and Values

20. We would like to have your personal opinion on the importance of science in society generally. Please circle your response for each statement on a five-point scale from "strongly agree" to "strongly disagree".

	Strongly agree				Strongly disagree
Science:					
A. makes collective decision making more technical and rational.	1	2	3	4	5
B. increases our standard of living.	1	2	3	4	5
C. provides us with better control over nature.	1	2	3	4	5
G. is essential for helping other people.	1	2	3	4	5
Knowledge of science:					
D. facilitates consumer choices.	1	2	3	4	5
E. provides information for better decision-making in society.	1	2	3	4	5
F. provides a sense of control over one's life.	1	2	3	4	5
H. helps to understand the world in which we are living.	1	2	3	4	5

21. In your opinion which of the following statements are more or less true:

A. Academic expectations of professors were unrelated to my gender

Very true 1 — 2 — 3 — 4 — 5 **Not at all true**

B. Interaction with faculty was unrelated to my gender

Very true 1 — 2 — 3 — 4 — 5 **Not at all true**

22. To what extent do you value the following:

	A great deal				very little
A. Relationships with other people	1	2	3	4	5
B. Competitive situations	1	2	3	4	5
C. Harmony in your work/study environment	1	2	3	4	5
D. Making decisions according to abstract rules and principles	1	2	3	4	5
E. Working/studying on your own	1	2	3	4	5
F. Forming personal attachments with fellow students	1	2	3	4	5
G. Evaluating the work of others	1	2	3	4	5
H. Working as part of a team	1	2	3	4	5
I. Taking a leadership role when doing group projects	1	2	3	4	5
J. Making decisions according to the particular context or situation	1	2	3	4	5
K. Handling conflict in your work/study environment	1	2	3	4	5
L. Debating or intellectual sparring	1	2	3	4	5
M. Highly structured study/work career path	1	2	3	4	5
N. Having affection for co-workers, fellow students	1	2	3	4	5
O. Very specialized study/work career path	1	2	3	4	5
P. Working with concrete facts	1	2	3	4	5
Q. Working in a supportive environment	1	2	3	4	5
R. Using deductive logic	1	2	3	4	5
S. Caring for others	1	2	3	4	5

Section 4 Educational Intentions

23. We would like to understand how choices are made concerning the selection of disciplines or fields of study. Briefly indicate why you selected the discipline or field of study you are in:

.....

.....

.....

.....

24. At what point do you feel that your intention concerning a specific area of study/work first began to emerge? (Circle only one.)

	Grades or Years												
In elementary school	1	2	3	4	5	6							
In Junior high school							7	8					
In high school									9	10	11	12	13
In university													

In university													
											1	2	3	4

25. Were your instructors in high school: (Please check ✓)

1 ☐ mainly women 2 ☐ mainly men 3 ☐ equally women and men

26. Were your role models in high school: (Please check ✓)

1 ☐ mainly women 2 ☐ mainly men 3 ☐ equally women and men

27. In your opinion, how important are the following abilities or capacities in your chosen field of study in order to be successful at the undergraduate level. Please check (√) your answer for each dimension.

	extremely important 1	very important 2	somewhat important 3	barely important 4	not at all important 5
General academic ability					
Ability in mathematics					
Ability to persevere					
Open-mindedness					
Ability to work long hours					
Ability to get along with other people					
Ability to communicate orally					
Ability to communicate in writing					
Mechanical capabilities					
Ability to work independently					
An enquiring mind					
High moral standards					
Problem-solving ability					
Planning and organizational ability					
Ability to assert oneself					
Ability to help others					
Ability to be punctual					
Ability to meet deadlines					
Desire to work independently					
Reliability					
Ability to adapt					
Others (please specify)					

28. We would like to find out how and when educational disciplines and career choices come into focus, and what the influencing factors in the final decisions are. Please tell us how important each of the following factors were in choosing <u>your major in your undergraduate program</u>.

	Very important				Not at all important
<u>How important were the following influences from within your home?</u>					
A. Your mother	1	2	3	4	5
B. Your father	1	2	3	4	5
C. Other family member	1	2	3	4	5
D. Others (please specify)	1	2	3	4	5
<u>How important were the following influences from high school?</u>					
A. Friends	1	2	3	4	5
B. Good marks in subject	1	2	3	4	5
D. High school teachers	1	2	3	4	5
E. Guidance counsellors	1	2	3	4	5
F. Interest in the subject matter	1	2	3	4	5
G. Other role models (please specify)	1	2	3	4	5
<u>How important was your assessment of your abilities?</u>					
A. Your logical abilities	1	2	3	4	5
B. Your writing abilities	1	2	3	4	5
C. Your mathematical abilities	1	2	3	4	5
D. Your communication abilities	1	2	3	4	5
E. Your interpersonal abilities	1	2	3	4	5
F. Your decision making abilities	1	2	3	4	5
G. Your artistic abilities	1	2	3	4	5
H. Other (please specify)	1	2	3	4	5
<u>How influential were your career experiences?</u>					
A. Summer employment experience	1	2	3	4	5
B. Full-time employment experience	1	2	3	4	5
<u>How important were the following perceptions and expectations?</u>					
A. Expectation of good marks	1	2	3	4	5
B. Continued interest in subject matter	1	2	3	4	5
C. Future income expectations	1	2	3	4	5
D. Career objectives	1	2	3	4	5
E. Lifestyle goals	1	2	3	4	5
F. Desire to be self-sufficient	1	2	3	4	5
G. To respond to the needs of others	1	2	3	4	5
H. Other (please specify)	1	2	3	4	5

29. **Briefly tell us which of the above influences was the most important one?**

.....

.....

Section 5 Career Aspirations

30. How do you rate the probability that after graduating you will:

	Very likely				Not very likely
A. Continue your studies :					
a) in your current field at the graduate level	1	2	3	4	5
b) take a professional degree related to your major	1	2	3	4	5
c) take a professional degree unrelated to your major	1	2	3	4	5
B. Leave university:					
a) but not join the labour force	1	2	3	4	5
b) choose work unrelated to your major	1	2	3	4	5
c) find a job in your area of study in: ----------> industry	1	2	3	4	5
----------> government	1	2	3	4	5
----------> education	1	2	3	4	5
----------> other	1	2	3	4	5

↓

Please specify .....

31. What job or position would you like to obtain? Please specify.

.....

.....

32. How do you see your immediate future in the work world? Please circle your intentions on the following scale:

Take any job right now . . . . . keep my options open . . . . . have definite career plan
1 - - - - - - - 2 - - - - - - - 3 - - - - - - - 4 - - - - - - - 5 - - - - - - - 6 - - - - - - - 7

33. In your selected field of work how difficult would it be for you to combine family and career responsibilities?

Very difficult ↓-------↓-------↓-------↓-------↓ **Not difficult at all**
1 2 3 4 5

34. How much has your university education contributed towards clarification of your career options?

	Very much - - - - - - **Not very much**
A. Helped to identify career options according to your skills	1 - - 2 - - 3 - - 4 - - 5
B. Understanding of your strength and weaknesses in relation to career interest	1 - - 2 - - 3 - - 4 - - 5

35. How often did you use the Career Centre or Career Services on campus?

[1] Never [2] Once [3] A few times [4] Once per semester [5] Often per semester

36. How satisfied were you with the Career Centre or Career Services on campus?

1. Very much
2. Much
3. Somewhat
4. Not very much
5. Not at all

37. What would have been most helpful to you in planning your future career? Please indicate briefly.

.....

.....

.....

Section 6 Overall Assessment

38. If you could relive your four years at university what, if anything would you do differently? Please indicate how important you would rank the following dimensions. (Ranking the top two (first choice = 1, second choice = 2), and the two least important dimensions (least important = 10, second least important = 9).

A) Study harder .....
B) Better study habits .....
C) Better balance of activities .....
D) Increased overall involvement .....
E) More academic counselling .....
F) Better planning of courses .....
G) Different courses .....
H) Another University .....
I) Different Program .....
J) Different field of study .....

first two choices = 1 - 2

last two choices = 10 - 9

K) Other (please specify) .....
.....
L) Nothing .....

39. All things considered, how satisfied or dissatisfied are you with your education at the University of Guelph?

1. very satisfied
2. somewhat satisfied
3. neither satisfied nor dissatisfied
4. somewhat dissatisfied
5. very dissatisfied

40. Any final comments or thoughts you want to share with us about your experiences at the University of Guelph?

Please turn page
---------->>

Thank you very much for your cooperation.

We appreciate the time and assistance you have provided.

Check here if you would like to receive a summary of the project findings when they become available ☐

Campus Mail Boxes

For Your Questionnaire

Locations:

UNIVERSITY CENTRE

1) Third floor at the busary's office opposite the door to the steps
2) Main floor opposite the Information desk next to the main doors and the internal telephone
3) Ground floor opposite the sign on the wall "Peter Clark Hall" in the red counter

MCKINNON BUILDING

4) Door of the mail room 037, ground level

JOHNSON HALL

5) Basement – near student mail boxes outside "Der Keller"

VET COLLEGE

6) Next to the telephones and student mail boxes in the basement
7) First floor next to the library outside the door of the Dean's office

ALL PORTERS

Please fold and seal the questionnaire.
Return through Campus Mail System.

- -

Campus
Mail

Students' Experiences and Outcomes

Department of Sociology/Anthropology
706 McKinnon Building, Ext. 6698
UNIVERSITY OF GUELPH
Guelph, Ontario N1G 2W1

APPENDIX 7.3

The Fall 1990 Interview

WOMEN IN SCIENCE

INTERVIEW COVER SHEET

INTERVIEWER: _____
ID NO. : _____

HI. MY NAME IS _____ THANK YOU FOR AGREEING TO BE INTERVIEWED.

AS YOU KNOW, WE ARE INTERESTED IN THE EXPERIENCES OF WOMEN IN SCIENCE PROGRAMMES AT THE UNIVERSITY OF GUELPH.

YOU MAY HAVE ALREADY RESPONDED TO A NUMBER OF SURVEY QUESTIONNAIRES, AND ON BEHALF OF THE RESEARCH TEAM I WANT TO SAY HOW MUCH YOUR COOPERATION IS APPRECIATED. THIS STUDY IS PART OF ONGOING RESEARCH CONCERNING STUDENTS' EDUCATION, CAREERS AND EDUCATIONAL OUTCOMES.

PARTICIPATION IN THE INTERVIEW, IN WHOLE OR IN PART, IS ENTIRELY VOLUNTARY AND THE INFORMATION PROVIDED IS ENTIRELY PRIVATE AND CONFIDENTIAL. UNDER NO CIRCUMSTANCES WILL INDIVIDUAL RESPONDENTS BE IDENTIFIED. YOU CAN DECLINE TO ANSWER ANY QUESTION OR TO CONCLUDE THE INTERVIEW WITHOUT ANY EXPLANATION, ALTHOUGH I WOULD BE WILLING TO LISTEN TO ANY REASONS YOU MIGHT PROVIDE.

HOWEVER, I THINK THAT YOU WILL FIND THIS INTERVIEW TO BE A P L E A S A N T A N D U S E F U L E X P E R I E N C E .

AS I MENTIONED IN MY CALL, THE INFORMATION YOU PROVIDE WILL BE TREATED IN ACCORDANCE WITH THE PROVISIONS OF THE ACCESS TO INFORMATION ACT. ACCESS TO THIS INFORMATION MAY BE OBTAINED BY QUOTING THIS REGISTRATION NO. :

MST/MST - 006 - 03960

IF YOU WISH TO HAVE A SUMMARY OF THE RESULTS OF THE PROJECT WHEN COMPLETED, I WOULD BE PLEASED TO PUT YOUR NAME AND ADDRESS ON THE MAILING LIST.

---- NO ---- YES

Please, indicate address if different from present one:

EDUCATION

FOR PERSISTERS ONLY

First of all I would like to learn a bit about your programme experiences:

1. a. What programme did you start in ?

   b. Why did you select that programme ?

   c. How long have you been in it ?

2. a. In general, how satisfied are you with your experiences in the programme ?

   b. Have you ever thought of leaving the programme ? Please tell me about those times.

3. Do you have any second thoughts about remaining in the programme ?

4. a. Did you ever consider taking or are you enroled in a graduate programme in science ?

   b. Why or why not ?

5. a. Are you presently working or employed in a science related area ?

   b. If no, why not ?

FOR LEAVERS ONLY

First of all I would like to learn a bit about your programme experiences:

1. a. What programme did you start in ?

   b. Why did you select that programme ?

   c. How long were you in it ?

   d. When did you first begin to think that you would like to leave the programme ?

2. a. What were the considerations that made you decide to leave the programme ?

   b. Was it an easy or difficult decision for you to make ?

3. What would it have taken (what would have had to change) to encourage or enable you to have remained in the science programme ?

4. a. In retrospect, do you have any second thoughts about leaving the programme ?

   b. Have you become more or less convinced that you made the right decision ? Why ?

FOR BOTH PERSISTERS AND LEAVERS

5. a. What are the events or situations which stand out in your mind regarding your total university experience ?

b. Probe, if necessary, things like important academic and social experiences, relationships with peers or instructors, specific assignments or courses, or residences aspects ?

6. Which experiences/events/situations in the science programme, made a lasting impression on you ?

7. a. If you had the power, is there any thing that you would **change** about the programme ?

b. Why ?

c. Probe: the kind of courses required; the way the teaching is done; the way assignments are handled - the kinds of assignments given and the way they are evaluated; the way students are expected - by themselves or by their professors - to relate to each other and/or to faculty members; the ways of thinking about the course content - i.e., is it too restrictive or narrow in any way ?)

8. What aspects of the science programme should **remain the same**?

9. a. What out-of-class activities exist for science students to participate in ?

   b. How satisfied are you with your involvement or participation in these various activities ?

   c. Could you have been more involved ? Why or why not ?

10. What aspects about the University did you find most helpful ?

11. Did the time you spent in the science programme change the way you think about yourself, science, or the world ?

12. In your learning at University, did you come across an idea that made you see things differently ... or think about things differently ?

13. Do you think being a woman is (was) an advantage or a disadvantage (or both) with respect to fulfilling programme and course requirements in the area of science ?

14. Are (were) there things that this (school, programme, environment) doesn't (didn't) provide that are important to you ?

15. Are there things which you would have liked to learn that you did not and could not learn here ?

16. Looking back over your whole life, can you tell me about a really powerful learning experience that you've had, in or out of school ?

SELF-DESCRIPTIONS

Now I would like to ask you a few more general questions about yourself.

17. Has the way you see yourself changed in any way since you first entered the programme ?

18. a. What do you think has led to the change ?

b. Probe: In particular, did your experiences with the programme contribute to your changing view of yourself ?

GENDER

The next few questions deal specifically with the issue of gender:

19. What does being a woman mean to you ?

20. Do you think there are any important differences between women and men ?

21. How has your sense of yourself as a women been changing ?

SENTENCE COMPLETION

Next, I would like you to complete the sentence items on this sheet of paper. Simply fill in your responses in the space provided.

Hand respondent sheets with Qs. 22 - 40.

CONCLUSION

Thank you very much for your cooperation. There are just two more questions to go.

41. What do you think you and your life will be like fifteen years from now ?

42. Are there any other questions that I should have asked you, that would have thrown some light on the kinds of experiences you had (are having) in the science programme at Guelph, especially as these experiences relate to your gender.

Well, we are finished. Thank you very much for your time and your comments. These in-depth answers will definitely be useful for our research. Thank you once again.

SENTENCE COMPLETION

22. Being with other people _____
23. Education _____
24. A good mother _____
25. The thing I like about myself is _____
26. Women are lucky because _____
27. I am _____
28. A good father _____
29. For a woman a career is _____
30. When I am criticized _____
31. A woman should always _____
32. What gets me into trouble is _____
33. Rules are _____
34. Men are lucky because _____
35. My main problem is _____
36. When people are helpless _____
37. My conscience bothers me if _____
38. The worst thing about being a woman _____
39. A girl has a right to _____
40. Raising a family _____

OPTIONAL CARD RESPONSES

XX. I would like to know what you think about these statements

a. Sometimes people talk about "searching for truth," What do you think people mean when they say that ?

b. Is that what scientists are doing, do you think ? Searching for truth ? Will they find it ?

c. How about artists (painters, writers, and so on) ? Are they searching for truth ?

XXX. "Sometimes I really get bored with education, because it is just sitting around listening to other people talk about things that are not important."