

Academic Progress of Canadian Engineering Students in terms of MBTI Personality Type*

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The Myers-Briggs Type Indicator was completed by most students entering first year engineering at The University of Western Ontario during the years 1987 through 1993, providing a stable personality profile of the entering class. A cross-cultural comparison of this Canadian engineering entry profile with similar MBTI data reported for American students from an ASEE consortium of six United States schools shows that the Canadian students include significantly more LFP types. Most of the students from this seven-year Canadian entry cohort have now graduated and this paper reports retention data, choice of engineering discipline and subsequent academic performance in that discipline in terms of personality type. This Canadian engineering program attracts students who, in comparison with other first year students, are more ISTJ at entry and furthermore the engineering program graduates a greater proportion of such students with this same ISTJ personality preference within four years.

INTRODUCTION

PROFESSIONAL ENGINEERS both in Canada [1] and the US [2] have identified an increased future demand for engineers who not only have broad-based technical competence but also the adaptability to cope with societal and technological change. In order that the profession can function in an increasingly multiracial and multicultural workplace engineering schools must attract all races and both genders. These future engineers will need an appreciation of society's environmental concerns, a commitment to the solution of environmental problems and the interpersonal skills to work effectively in groups towards their solution. It would therefore be of serious concern if engineering schools were unable to attract, or maybe retain, those students whose personality preferences would dispose them to be good communicators, outgoing, creative and naturally attuned to consider the human aspects of any situation.

A longitudinal study of a seven-year cohort of entry engineering students at the University of Western Ontario (UWO) is investigating the academic performance, the choice of engineering discipline and, eventually, the job satisfaction after graduation as a professional engineer in terms of personality type as recorded by the Myers-Briggs Type Indicator (MBTI).

This paper summarises in relation to personality type the academic progress for this seven-year UWO cohort and presents data on the students'

choice of discipline, attrition and graduation results. The final part of the project, to be reported later, is the result of a survey of a subset of the students from the MBTI cohort investigating their job type, responsibility level and satisfaction as graduated professional engineers.

THE MYERS-BRIGGS TYPE INDICATOR

Jung's theory of psychological types assumes that much apparently random human behaviour is really quite orderly and consistent and reflects the different ways persons take in information and make decisions. The Myers-Briggs Type Indicator is a self-report instrument based on Jung's theory of psychological types. The instrument returns the respondent's preferences on each of the four dimensions extraversion/introversion, sensing/intuition, thinking/feeling and judging/perceiving. Thus the MBTI describes sixteen possible types such as INTJ, ENFP, etc. which result from the dynamic interplay of these four preferences. All types are good, all types are normal, and none is superior to the others. However, the preferences of one type may match the demands of particular situations better than the preferences of other types.

The eight MBTI preferences are well described in the literature, especially by McCaulley [3], and the following are simply brief descriptions of these preferences. Some people are oriented to a broad-brush approach with quick action; others are oriented towards thoughtful reflection of concepts and ideas. Jung calls these orientations

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extraversion (E) and introversion (I). Some people are attuned to the practical, hands-on, common-sense view of events whereas others are more attuned to implications, possibilities and meanings of events. These styles of perceiving are known as sensing (S) and intuition (N). Some people typically draw conclusions or make judgements objectively, dispassionately and analytically; others weigh human factors, consider societal implications and make judgements with personal conviction as to their value. These decision-making styles are called thinking (T) and feeling (F) respectively. Lastly, some people gather only enough information to make a decision, then stay on a direct path towards that goal whereas others are more open to changing situations and new developments which might require changing strategies or setting new goals. These preferences are called judgement (J) or perception (P).

The sixteen possible personality types for any group of MBTI respondents are usually displayed as a 4×4 arrangement known as a type table. Such MBTI type distributions may readily be compared with other type tables using Selection Ratio Type Table (SRTT) software [4], which uses a 2×2 chi square tests to check for significant differences between the two distributions.

The results shown below are obtained from SRTT chi-square analyses which generate sample differences not only as main effects on the four bi-polar dimensions but also as cross-dimension letter pairs such as IJ, FP, ES, etc. and also for combinations of three and four letters. The results below do not show all these detailed type difference combinations but highlight the more significant type difference trends obtained from the SRTT analyses.

RESULTS

Cross-cultural comparisons of american and canadian student groups

The MBTI types of a group of first-year Canadian general science and humanities students, 55% female, (Casas [5]) when compared with the types of a large group of American traditional college age students, 53% female, (MBTI Atlas [6]) showed that the Canadian students were significantly more *_NTP* type oriented. A comparison between the male students within each of these groups shows that the Canadian male students are more *IN_P*.

The current study provides data for another cross-cultural comparison, this time of engineering students. The Canadian UWO engineering students ($n = 1865$, 14% female) in contrast to American engineering students from an ASEE six-school consortium [3] ($n = 2032$, 18% female) were significantly more *I_FP* and this same cross-cultural type difference existed between the two groups of male students.

Although more studies are needed to confirm

these trends, it is suggested that Canadian male students are more *I_P* than their American counterparts and that Canadian male engineering students are more *I_FP* than American male engineering students.

These cross-cultural differences on the I and P dimensions support the view that American students are generally more outgoing and realistic, organised and goal-oriented (i.e. more E and J) than their Canadian counterparts. Such differences also emphasise that MBTI research findings should only be generalised cross-culturally with caution.

Common personality preferences amongst engineering students

A type comparison of American students between the ASEE six-school cohort [3] of engineering students and the large group of traditional age college students shows that the engineering students are significantly more *INTJ*. A similar comparison of Canadian students between the UWO entry engineering students and the University of Ottawa anglophone science/humanities students shows that the engineering students are significantly more *ISTJ*.

Both these groups of entering engineering students are significantly more *I_TJ* than the general first-year entry. Part of the apparent difference between the American and Canadian engineering groups on the *S/N* dimension could be attributable to differences between the general student groups in which, as was shown above, the Canadian students were more intuitive (N) than the American group.

If the entry engineering students, Canadian and American, are compared directly there is no difference on the *S/N* dimension but the UWO Canadian students are significantly more *I_FP* as shown in Table 1.

Graduation in engineering and personality type

Figure 1 shows the current status of the 1865 students in the seven-year UWO cohort. About 57% of the group have already graduated in engineering and a further 7% will probably do so. Another 16% have graduated or will graduate in other non-engineering UWO programs, bringing the total proportion of graduates from the original entry cohort to 80%. The remaining 20% of students withdrew from the university in most cases because they were required to do so because of their academic performance.

The graduation data at Table 2 shows that the engineering graduates are more *I_TJ* than the entry group and that the students who graduate in the minimum time of four years, usually the better students, are more *ISTJ*. The American data from the ASEE six-school consortium showed that retention in engineering was associated with *I-J*. Insofar as the American students were already significantly more *_T_* than the Canadian students at entry, it seems that both engineering programs

Table 1. MBTI percentage splits for entry engineering students

	n	I%	S%	T%	J%
ASEE six-school	2032	51	53	78	66
UWO	1865	58	55	73	54

show a predisposition to attract and graduate students with an I_TJ preference.

The male graduates showed the same I_TJ preference as the total graduate group but the female graduates showed a tendency to be more IN_ than their entry group. The females in comparison with the males were more ENFJ both when entry groups were compared and also when graduate groups were compared. This female personality preference would have suggested that the females were less suited to perform well in the I_TJ engineering program. This was not the case however as the female graduation rate (68%) was higher than the male graduation rate (56%). This result highlights that one obvious way to increase those personality types which are currently in a minority amongst the graduating engineers would be to increase the numbers of female students.

The most persistent type letter common to all the graduating groups including female students is J (judging). This serves to underline the fact that engineering programs are busy programs with lots of assignments, laboratory reports and design projects and it is the orderly and

Table 2. Engineering graduation data and personality type

Population (n)	Sample (n)	Type difference of sample
total entry (1865)	graduates (1071)	I_TJ
total entry (1865)	four-year graduates (565)	ISTJ
female entry (264)	graduates (180)	IN_
female entry (264)	four-year graduates (96)	n.s.d.
male entry (1601)	female entry (264)	ENFJ
male graduates (891)	female graduates (180)	ENFJ

systematic J's who thrive in this world of deadlines and schedules.

Attrition and personality type.

Figure 1 shows that, to date, 1071 (57%) of the original entry cohort of 1865 students have graduated in engineering and these graduates have an over-representation of I_TJ and ISTJ personality types. It is not surprising therefore that an SRTT analysis of the remaining 794 (43%) students shows them to be significantly ESFP in comparison with the entry cohort. These remaining students consist of graduates in other disciplines, students who are still in university programs and students who have withdrawn from the university.

The predominant personality types of those students who withdrew from the engineering program and also from the university are shown

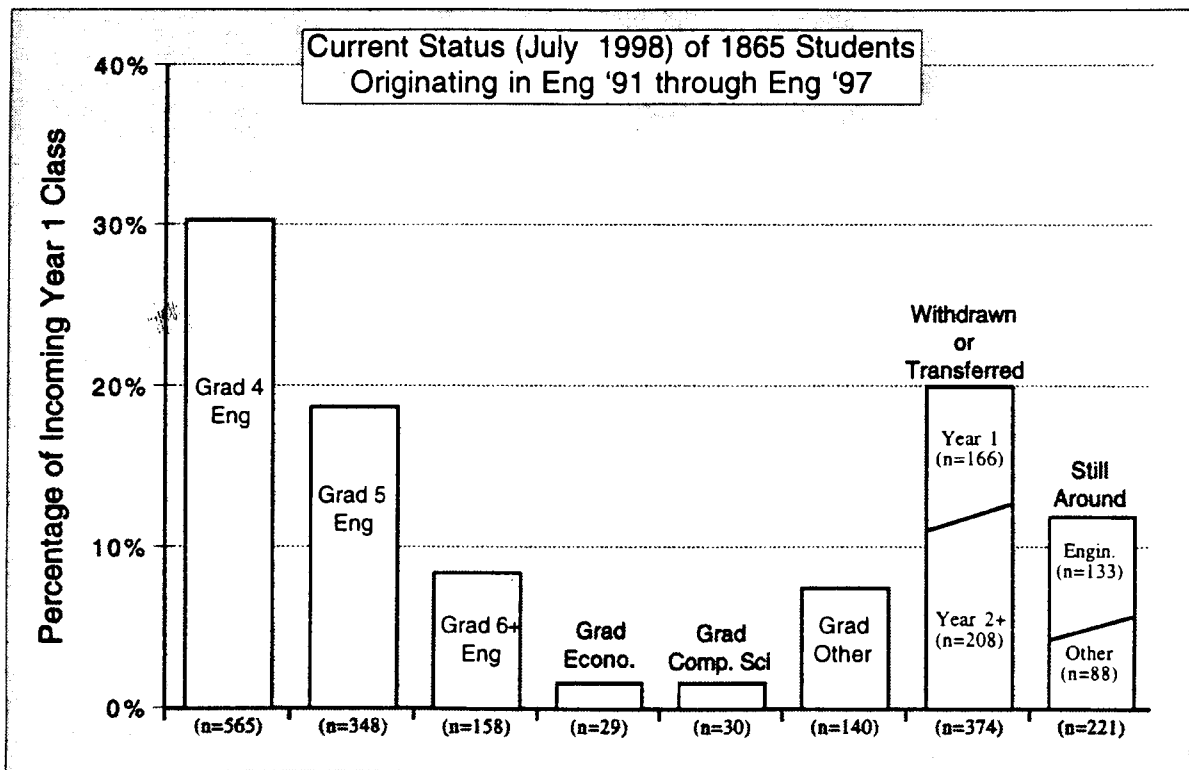


Fig. 1. Status of UWO engineering entry cohort.

Table 3. Student withdrawals (WDL) and personality types

Population (n)	Sample (n)	Type difference of sample
total entry (1865)	total wdl (374)	_SFP
total entry (1865)	Year 1 wdl (166)	_SFP
total entry (1865)	Year 2+ wdl (208)	n.s.d.
male entry (1601)	male wdl (344)	_SFP
male entry(1601)	Year 1 wdl (149)	ESFP
male entry (1601)	Year 2+ wdl (195)	n.s.d.

in Table 3. The proportion of total entry students who withdrew was 20% and this attrition group was significantly more _SFP than the entry group. If this attrition group was separated into first-year withdrawals and upper year withdrawals, it was found that the first-year withdrawals showed the MBTI preference for _SFP but that the upper year withdrawals were not associated with any particular personality preference.

The proportion of withdrawals amongst female students is significantly lower than for males and they show no particular type preference, partly due perhaps, to their smaller numbers being too low to indicate statistical trends. The total male withdrawals on the other hand show a significant preference for _SFP and the first-year male withdrawals are ESFP. It would seem that many male students who experience a lack of fit between their E_FP preference and the I_TJ program do so in

their first year and do not survive at university for more than one year.

Type and choice of engineering discipline at uwo

After the common first-year program the engineering students select one of the five disciplines; chemical, civil, electrical, materials or mechanical.

The choice of engineering discipline for both male and female students is shown in Fig. 2. The relationship between choice of discipline and personality type is shown in Table 4. There is a significantly larger proportion of females choosing chemical engineering and a significantly smaller proportion of females choosing electrical. The predominant type of the students choosing electrical is INTJ, so it is not inconsistent with personality type that the female students, who have already been shown to be more ENFJ than the males, might be under-represented in the electrical engineering discipline.

The students selecting chemical or materials engineering were not significantly different by type from the entry group. The students selecting civil were significantly more S, which probably demonstrates their preference for the real, practical, hands-on aspects of civil engineering.

Students who transferred from engineering and subsequently graduated in other programs at UWO were significantly ENFP compared with the engineering entry class. This group of students

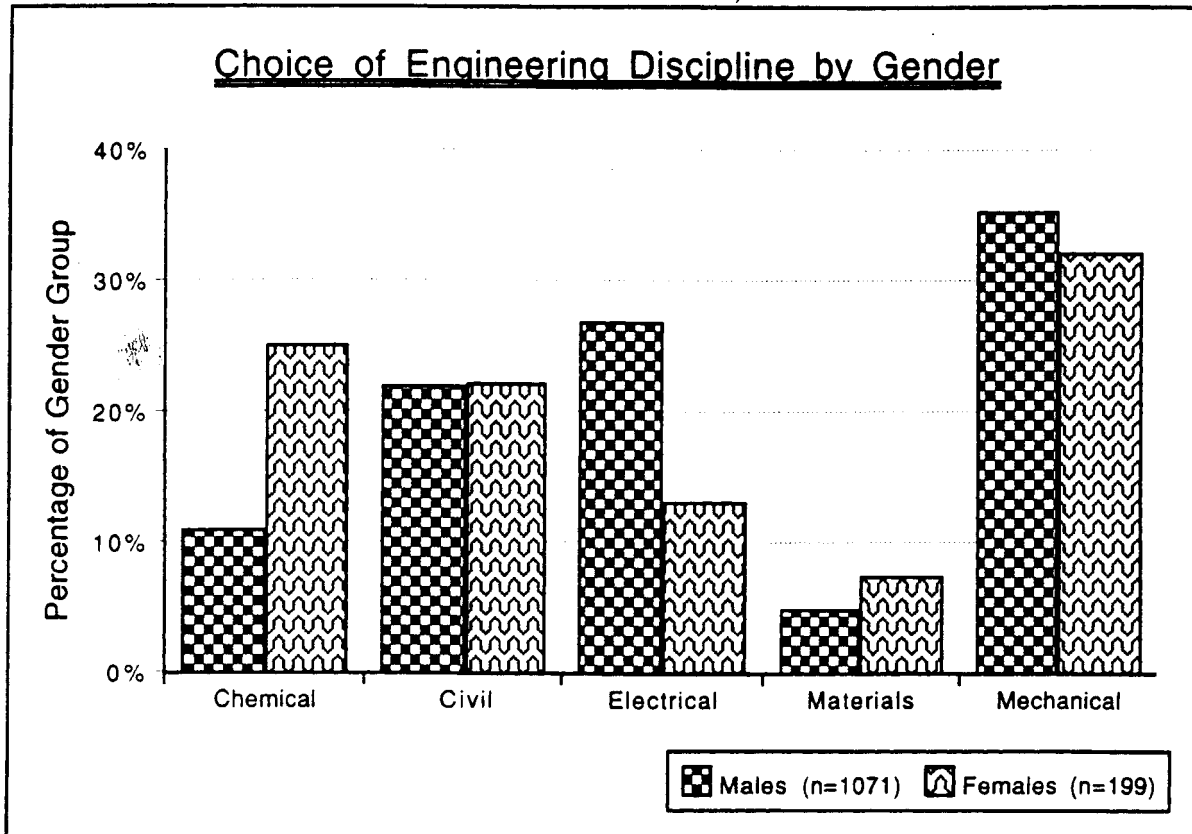


Fig. 2. Choice of engineering discipline.

Table 4. Choice of engineering discipline and predominant type of sample

Discipline	All students (base n = 1865)	Male students (base n = 1601)	Female students (base n = 264)
Chemical	n.s.d	n.s.d.	n.s.d.
Civil	_S_J	_ST_	_SF_
Electrical	INTJ	INTJ	n.s.d.
Materials	n.s.d.	n.s.d.	IN_P
Mechanical	_NT_	_NT_	_T_
Other programs	ENFP	ENFP	ENFJ

successfully graduating in other programs has the exact opposite type to the type of the four-year engineering graduates (ISTJ), which emphasises that personality type is not indicating academic ability so much as the fit between student interests and program demands.

Implications for changes to the engineering programs

The engineering profession needs all personality types especially those people who are good communicators, outgoing, creative and naturally attuned to consider the human aspects of any problem. Most engineering courses are presented in a way that better suits students with a preference for introversion, intuition, thinking and judging. Consequently, students with an I_TJ preference dominate the engineering graduate group, while male students with an ESFP preference are over-represented among withdrawals and male students with an ENFP preference are over-represented in the group which transfers and graduates in other disciplines. Therefore program additions which accommodate the preferred learning styles of ESFP's should result in increased retention in engineering. An added bonus would be that any changes made to accommodate E_F_ learning preferences would appeal especially to female students who are significantly more E_F_ than the male students.

Specific suggestions [7] for modification of the program would be to incorporate more active group work (E and F); more spontaneous discussion, informal problem-solving and creative discovery tasks (P); discussion of aesthetics, ethics and social factors, work with mentors

and groups (F); and more specific, practical, hands-on realistic tasks (S). Insofar as student withdrawals from the engineering disciplines are highly P, the single most important change to increase student retention would be to help students to organise their time, systematically allocating it to different subjects and to the prompt completion of assignments and laboratory reports.

CONCLUSIONS

This study shows that the MBTI provides an insightful perspective on the personality preferences of different groups of engineering students and their progress through the engineering program. More studies are needed to confirm the following results:

1. Canadian engineering students are more I_P than American engineering students.
2. Canadian entry engineering students are more ISTJ than the general first-year students and the engineering graduates are even more ISTJ than the entry group.
3. Although female engineering students are more ENFJ than the males, they are at least equally successful in the engineering program.
4. Male students withdrawing from the UWO engineering entry are significantly more _SFP_.
5. In comparison with the engineering entry class there is a tendency for civil students to be more _S_ for electrical students to be more INTJ and for those students graduating in other non-engineering programs to be more ENFP.

REFERENCES

1. A. Meisen and K. F. Williams (eds), *The Future of Engineering Education in Canada*, Canadian Council of Professional Engineers and the National Committee of Deans of Engineering and Applied Science, 116 Albert Street, Suite 401, Ottawa, Canada (1992).
2. R. P. Morgan, P. R. Reid and W. A. Wulf, The changing nature of engineering, *ASEE Prism* (June 1998).
3. M. McCaulley, G. Macdavid and R. Walsh, Myers-Briggs Indicator and retention in engineering, *Int. J. App. Engin. Ed.*, **3**, 4, (1987) pp.99-106.
4. M. H. McCaulley, The Selection Ratio Type Table: a research strategy for comparing type distributions, *J. Psych. Type*, **10** (1985) pp.96-106
5. E. Casa, *Les Types Psychologiques Jungiens*, Psychometrics Canada Ltd, Univ. of Alberta (1990).
6. G. P. Macdavid, M. H. McCaulley and R. I. Kainz, *MBTI Atlas of Type Tables*, C.A.P.T., Gainesville (1986).
7. M. McCaulley, The MBTI and individual pathways in engineering design, *Engin. Ed.*, **80**, 5 (1990) pp.537-542.

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