Students' Psychological Type and Success in Different Engineering Programs

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Abstract - A longitudinal study of a seven-year cohort of engineering students at The University of Western Ontario aims to document student academic success in the university engineering program and subsequent satisfaction in the engineering profession in terms of personality type as reported by the Myers-Briggs Type Indicator (MBTI).

Results for the full seven-year cohort show that success in first year is more probable, certainly for the weaker students, if their personality type is I_TJ. Also, in a cross-cultural comparison with a similar group of American students the Canadian cohort of entry students is significantly more I__P.

The graduation data for the first five years of the cohort show that successful graduation in engineering is also associated with I_TJ personality types and that graduation within four years is correlated with INTJ types. Data is also presented regarding student’s choice of engineering discipline in terms of their MBTI type.

Introduction

A continuing project at The University of Western Ontario (UWO) is investigating the student's choice of engineering discipline and subsequent academic performance in that discipline in terms of their personality preferences as recorded by the Myers-Briggs Type Indicator (MBTI). Later this year, the study will be extended beyond the university setting to UWO alumni who are practising as professional engineers in order to relate their job description and job satisfaction to their personality type.

The total UWO student cohort who have completed the MBTI consists of engineering entry students over a seven-year period. All of these students have now completed the first year of the UWO engineering program, which is common for all engineering disciplines. The MBTI profiles of this seven-year cohort of Canadian students described both at entry to the first-year program and also at successfully passing from the first-year program is compared below with similar results from an ASEE[1] cohort of American engineering students, enabling some cross-cultural comparisons.

After the common first-year engineering program, the students at UWO select one of five available engineering disciplines (chemical, civil, electrical, materials or mechanical) which they pursue until graduation. Some students from the full seven-year student cohort have not yet progressed to graduation, so the results in this paper, concerning choice of engineering discipline and success in that discipline, are for the 1314 students from the first five years only of the total seven-year cohort.

The Myers-Briggs Type Indicator

The MBTI is a self-report questionnaire based on Carl Jung's theory of psychological types. It feeds back to respondents in a useful and organised form their expressed personality preferences. There are eight of these preferences which are paired along four bi-polar scales. There are no right or wrong responses and all eight preferences are equally valid. However, the preferences of one type may match the demands of a particular situation better than the preferences of other types.

Extraverts(E) are those who take a broad-brush approach to life with quick action and who are energized by people and things in the external world while introverts (I) are reflective and more energized by ideas in their inner world. Perceiving styles are divided into sensing (S), which emphasises facts, details and reality and intuition (N) which focuses on ideas, implications and possibilities. The decision-making process for those with a thinking (T) preference is objectively based on logic and analysis and for those with a feeling (F) preference is based more on personal values involving societal and human factors. The fourth dimension reflects a person's lifestyle attitude: the judging (J) attitude focuses on planning and deciding whereas the perception (P) attitude is more oriented to changing possibilities and new developments.

In total, the MBTI describes sixteen possible personality types such as ISTJ or ENFP, etc. which result from the dynamic interplay of the four preferences. These sixteen MBTI types are usually displayed as a 4 X 4 arrangement known as a Type Table. MBTI type tables for different groups of people may readily be compared using the Selection Ratio Type Table (SRTT) software[2], which uses 2 X 2 chi-square tests to check for significant differences between the two groups.

Results

The results shown below are obtained from SRTT chi-square analyses which generate sample differences not only for the four bi-polar dimensions but also for cross dimension combination letter pairs such as II, SF, NP, etc. and also for combinations of three and four letters. The following results are tabulated for clarity as simple percentage splits on the four main dimensions and any additional cross-dimension paired differences at high significance levels are described in the text.
Cross-cultural differences in first-year engineering

Table 1 shows the percentage splits for the full seven-year cohort of Canadian engineering students[3] in comparison with a similar group of American engineering students and also with an American group of general first-year university students from the Center for the Application of Psychological Type (CAPT) [1] data base. The American engineering students in comparison with the general first-year CAPT group confirm earlier data that the engineering program attracts introverts, thinking and judging types.

The cross-cultural comparison of engineering entry American students with engineering entry Canadian students shows the Canadian students to be significantly more I, F and P (p < 0.001). If a similar American/Canadian cross-cultural comparison is made[3] for engineering students successfully passing first year it is found that the Canadian group has now become more T and these successful students are only different from the American group by being more I and P. It is concluded that Canadian engineering students are significantly more I and P than their American counterparts. This difference might well be attributable to cross-cultural factors rather than to characteristics of the particular engineering schools. It could be that American students are indeed more outgoing (extravert) and decision focused (judging) than the Canadians but such a difference needs validation from further studies with larger student populations.

Academic performance in first-year engineering

Also shown at the bottom of Table 1 are the percentage splits for the group of students who obtained a clear pass (overall average mark of 60%) in the Canadian first-year engineering program. This successful group is significantly more I, T and J than the entry group. If the performance of the male students (86%) and the female students (14%) are analysed separately it is found that the trend for the passing students to be I, T and J is only shown at a significant level amongst the male students. This gender difference awaits future confirmation, however, as the larger numbers of male students make it more likely that differences in their preferences will show at a significant level.

Most Canadian students gain entrance to university on the basis of their Grade 13 marks from high school. If on the basis of these high school averages the engineering entry students are divided into two groups - students (41%) with Grade 13 entry marks of 80% or above and the rest (59%) with Grade 13 entry marks of 79% or less and others - and the first-year performance of these two groups is analysed separately, it is found that the 80%+ group succeeds uniformly in the program irrespective of type whereas the 79%- group are more successful if their type preference is I, IN and II (p<0.001) and T and TJ (p<0.01). Therefore, the students who are stronger academically pass first year irrespective of their type but students from the weaker academic group are more likely to be successful in first year engineering if their personality types are similar to INTJ. Conversely, there is a higher attrition rate amongst the weaker academic group for students with ESFP type preferences.

The Canadian female engineering students compared with the male engineering students are more EJ and FJ (p<0.001) and more J and SF (p<0.01). This female ESFJ preference exists for comparisons of the entry student groups and also for comparisons of the "passing first-year" groups and would predict the female students to be less successful in the first-year program. This is not the case: their success rate (67.7%) is at least as high as for male students (65.1%). An SRTT analysis of the entry and passing female students shows that they also pass "unfiltered by type" through the first-year program, indicating perhaps that they are academically stronger students. Larger numbers of students are needed to confirm the statistical reliability of these trends.

Academic performance to graduation

Data is presented at Table 2 for the overall academic performance in both engineering and other programs of those students (n=1314) from the first five years of the total cohort. The majority (64%) of the students in this five-year cohort has now graduated but 13% are still in academic programs at UWO and 23% have withdrawn from UWO.

Once again those students academically successful in graduating from engineering are more TJ, J and II. This I-TJ emphasis in the graduating group in comparison with the entry group is associated with the male students, partly because of their larger numbers, and there is no significant type difference for female students. However, the proportion (66%) of female students graduating in engineering is significantly greater (p < 0.001) than the proportion (52%) of male students. Another factor is that the entry female students are significantly more J than their male counterparts and this would result in their more

Table 1. MBTI Percentage Splits for First-Year Students.

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>I%</th>
<th>S%</th>
<th>T%</th>
<th>J%</th>
</tr>
</thead>
<tbody>
<tr>
<td>General first-year (CAPT)</td>
<td>11,122</td>
<td>45</td>
<td>56</td>
<td>33</td>
<td>53</td>
</tr>
<tr>
<td>American Engineering Entry</td>
<td>2,032</td>
<td>51</td>
<td>53</td>
<td>78</td>
<td>66</td>
</tr>
<tr>
<td>Canadian UWO Entry</td>
<td>1,913</td>
<td>58</td>
<td>55</td>
<td>73</td>
<td>54 ***</td>
</tr>
<tr>
<td>Canadian UWO Passing</td>
<td>1,252</td>
<td>61 ***</td>
<td>55</td>
<td>76 ***</td>
<td>57 **</td>
</tr>
</tbody>
</table>

*** p < 0.001 ** p < 0.01
organised and systematic approach to studying and consequent earlier graduation.

Table 2 also shows that the students who transfer out of engineering and complete a degree at UWO in another area are significantly F in comparison with the entry cohort.

The SRTT analysis shows that they are also NF. The intuitive (N) students (together with the introverts (I)) have been documented elsewhere[4] as having superior academic aptitude and in this case they are combined with F types who do not naturally approach decision-making in the impersonal, objective, analytical way encouraged in most engineering courses.

The graduation data for the same five-year cohort is shown in a different form in Figure 1. The engineering graduates are grouped into four-year graduates, five-year graduates and six- and-six-plus year graduates. The four-year graduates in the busy engineering program would predictably be students who are systematic and highly organised in their studies and this is confirmed by an SRTT analysis which shows the group of four-year graduates to be significantly J as well as TJ, IJ and NJ in comparison with the entry cohort.

In summary of the overall performance of students in the engineering program, the group of students with a clear pass in first year and the engineering graduate group are both I, TJ in comparison with the engineering students at entry and this trend applies only to male students, the statistically larger group. The group of students graduating in four years are significantly

**Choice of engineering discipline**

The percentage splits for students selecting the five different engineering disciplines available at UWO are shown in Table 3. The most popular disciplines during this period were electrical and mechanical and some (about 10% on average) of the students selecting these disciplines were not accepted into them. The personality types associated with those students selecting electrical were significantly I, IJ, NJ and IN and with those selecting mechanical were significantly N and T. Those same
<table>
<thead>
<tr>
<th>Discipline</th>
<th>n</th>
<th>I%</th>
<th>S%</th>
<th>T%</th>
<th>J%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canadian UWO entry</td>
<td>1,314</td>
<td>60</td>
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<td>73</td>
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<td>61</td>
<td>74</td>
<td>56</td>
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<td>Civil Engineering</td>
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<td>218</td>
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<td>53</td>
<td>72</td>
<td>59</td>
</tr>
<tr>
<td>Materials Engineering</td>
<td>53</td>
<td>51</td>
<td>53</td>
<td>74</td>
<td>57</td>
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<tr>
<td>Mechanical Engineering</td>
<td>326</td>
<td>59</td>
<td>51</td>
<td>79</td>
<td>54</td>
</tr>
<tr>
<td>Discipline withdrawals</td>
<td>94</td>
<td>63</td>
<td>44</td>
<td>76</td>
<td>41</td>
</tr>
</tbody>
</table>

** p < 0.01  *  p < 0.05

Table 3. MBTI Percentage Splits for choice of discipline

personality preferences associated with academic aptitude (IN--) and with success in first-year engineering at UWO (I-TJ) are also associated with selecting the preferred UWO engineering disciplines of electrical and mechanical.

The students selecting chemical or materials engineering were not significantly different in type from the entry students. The students selecting civil engineering were significantly more sensing (S), probably attracted by the real, practical, hands-on aspects of the discipline.

There were no significant type differences between male and female students in their selection of engineering disciplines. However, chemical engineering was selected by a significantly greater proportion of female students.

Also shown at Table 3 are the percentage splits for those students who withdrew (or were required to withdraw) sometime during or after the second-year program. These students were significantly more N and P and also more TP and NT. So these students self-report preferences for two of the letters (N and T) associated with success in the engineering program but they are also, as a group, highly perception (P). The perception types, who are easy-going, divergent thinking and more interested in exploring projects than completing them, do not succeed well in the engineering programs, replete with assignments, laboratory reports and due dates. Withdrawals from individual engineering disciplines were relatively few in number and were only significantly related to personality type in the case of withdrawals from electrical who were significantly N and P.

In summary, these results indicate that the personality types of students who are less successful in engineering programs are significantly E_FP. The engineering profession, however, needs all personality types especially those people who are good communicators, outgoing, creative and naturally attuned to consider the human aspects of any situation. Specific suggestions[5] for modifications in the engineering program to make it more attractive for E_FP types would be to introduce more active group work, more spontaneous discussion, informal problem-solving and creative discovery tasks, group project work and a mentor system.

**Conclusion**

The continuing engineering students in the UWO program are more I_P than a comparable group of American engineering students and it is suggested this represents a cross-cultural Canadian/American difference.

Compared with the entry class, the personality types of academically successful engineering students both in first year and also at graduation is significantly more I_TJ. The subset of students graduating in four years is INTJ.

The personality types of students choosing electrical were IN_J, choosing mechanical were _NT_ and choosing civil were S: reinforcing the suggestion that the more able students (INTJ) were selecting the preferred disciplines of electrical and mechanical. Students withdrawing from engineering after second year were significantly perception (P), accentuating the fact that in a busy program like engineering it helps to have the more highly organised judging (J) personality preference.

Students transferring from engineering and successfully graduating in other faculties were significantly NF_.

**References**