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AC 2011-1469: PERSON-THING ORIENTATION AS A PREDICTOR OF ENGINEERING PERSISTENCE AND SUCCESS

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Person-Thing Orientation as a Predictor of Engineering Persistence and Success

Abstract

Interest has emerged as an important factor affecting the recruitment and persistence of engineering students. In this study interest is operationalized as a differential orientation to persons called Person Orientation (PO), distinguished by an interest in interpersonal interactions, and an orientation to things called Thing Orientation (TO), distinguished by a desire for mastery over objects. This study was conducted in two phases with approximately one thousand engineering students. The first set of data was collected when the students were in their first year, and the second set of data was collected from the same population of students in their fourth (and for many their graduating) year. Students' person and thing orientation were measured along with their GPA, and their intention to pursue an engineering major (in their first year) and an engineering career (in their fourth year). The results showed that male engineering students in this sample tended to be higher in thing orientation and that thing orientation was a significant predictor of both an intention to pursue an engineering major and an engineering career.

Background

One of the most prominent problems currently in engineering education is the relatively low numbers of students enrolling and persisting in engineering. A recent study¹ has demonstrated that engineering retains a large number of the students who initially enrolled (50%). However, the number of students who enter, remain and succeed in engineering can still be improved. A number of studies have investigated the factors that motivate students to choose to enter and remain in engineering^{2,3}. These have been found to include the possibility of earning a high income, the possibility of rewarding career opportunities⁴, the prestige associated with engineering, the belief that engineering makes the best use of their talents and abilities^{5,6}, influence of friends and mentors⁷, and familial expectations⁸, and an aptitude for math and science².

Prior research has posited that achievement is a product of ability and motivation so both must be present for performance to be positive⁹. Motivation is perceived as more malleable than ability, therefore recent research has focused on motivation. This paper examines interest as a motivational influence. Vocational interest can be characterized as two dimensions: a Person-Thing dimension (PT) and an Ideas-Data dimension (ID)^{10,11}. This study focuses on the Person-Thing dimension for two reasons: sex differences in major and career choice are largest along this dimension¹², and engineering is commonly typified as a discipline that primarily deals with the creation and manipulation of man-made artefacts as opposed to a discipline centered on interpersonal interaction, or data manipulation.

Interest, especially in the United States, is an important motivation for students in choosing a major and the strength of their commitment to remaining in that major. Interest has also emerged as a significant factor in encouraging students to pursue careers in STEM fields^{13,14}. A number of studies have demonstrated a strong relationship between students' interests and abilities and their

persistence in engineering². It is therefore logical to assume that students who choose a major which makes the best use of their skills and engages their interest, are more likely to not only stay, but also thrive in the field of engineering which they choose. Students who make a poor choice, because of incomplete information or misconceptions about various disciplines, often find themselves frustrated and sometimes leave engineering altogether.

In the examination of engineering students' reasons for persistence and success, interest has not received an in-depth treatment. Interest as a motivational factor can be characterized and operationalized in several ways. For this study interest has been operationalized as a differential orientation to persons, distinguished by an interest in interpersonal interactions, and an orientation to things, distinguished by a desire for mastery over objects. This study, explored the stability of these person-thing traits across this group of students to determine whether it is a stable part of their disposition, or whether it changed over the course of their college education. The study also examined the success of the person-thing orientation measure in predicting students' persistence and success in engineering.

The findings reported here are a work in progress as data collection is still ongoing for this project.

Method

These data were the result of a mixed methods study conducted at a large Midwestern university with approximately one thousand students. The data were collected in two phases. The first phase yielded qualitative and quantitative data collected from students in their first year using an electronic survey. Students were asked about their achievement, interests (operationalized as PO and TO using a validated scale¹⁵), future plans, extra-curricular activities, motivations, whether they intended to remain in engineering (measured using a three item scale developed by the researchers), and family background. In addition students reported how they learnt about engineering, what influenced them to pursue a major in engineering and to favor particular engineering disciplines. The second phase of the study solicited responses from the same group of students four years later, again using an electronic survey. This survey collected a similar set of data. Since data collection for the second phase is ongoing, for this paper a random sampling of half of the responses received to date were used in the analysis. The PO and TO data were collected using the revised Person-Thing Orientation Scale¹⁵. This paper reports only on the PO, TO, GPA, sex, and intention to persist variables. ANOVA and multiple regression analysis were used to analyze the data.

Participants

The initial participants in this study were drawn from an introductory engineering course at a large Midwestern university. Approximately 65% of that class participated in the survey. The initial sample contained 967 engineering students of whom 153 were women (*Table 1*). For the second phase of the study the 298 participants were randomly drawn from the population of students who made up the initial class. Therefore while there is a large overlap in the samples, there are unique students in both sets. However, both samples represent the same population of students four years apart.

Table 1: Participant breakdown by group and sex

	First year		Follow up	
Sex	Men	Women	Men	Women
Count	812	153	202	96
% of population	84%	16%	68%	32%

Results and Discussion

An analysis of the data revealed that students in both the first and follow up groups were higher in thing orientation than person orientation, but that while person orientation increased slightly over the four years, thing orientation decreased (*Figure 1*). A significant main effect of group membership on thing orientation was found $F(1,1154) = 9.72, p = 0.002$ but analysis of variance tests did not reveal a significant effect of group membership on person orientation.

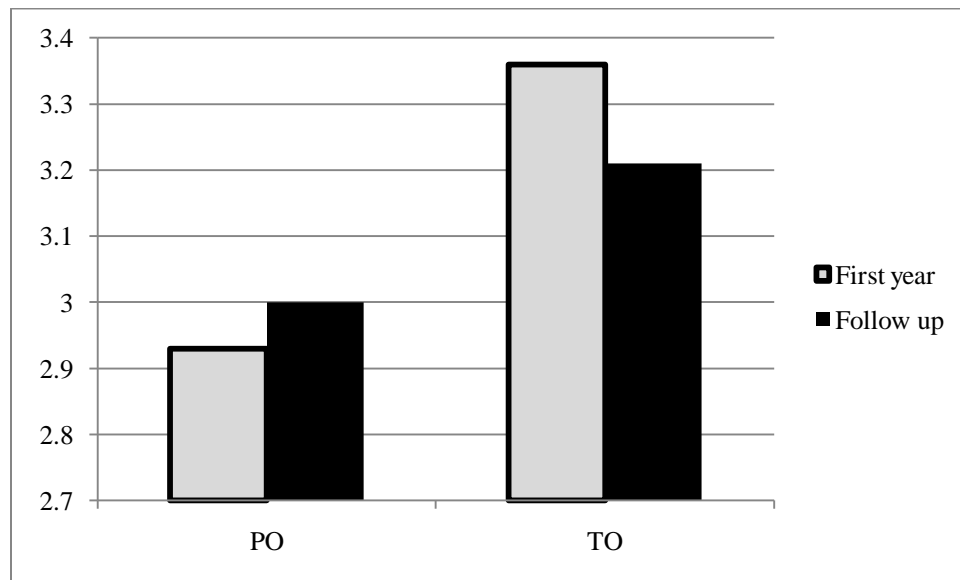


Figure 1: Mean person and thing orientation scores in the first year and follow up group

When PO and TO were examined by sex, it was observed that male students were higher in thing orientation while female students were higher in person orientation (*Figure 2*). This may be due to social influences which encourage boys to manipulate objects (e.g. play with and take apart cars, computer games, mechanical toys, etc) and pursue mastery, while girls are encouraged to

pursue more interpersonal activities and get along with others. Therefore female students do not develop the same familiarity with objects and mastery motivation in general and therefore have little opportunity to develop these interests. A main effect of sex was observed on both person and thing orientation $F(1, 1154) = 76.37, p < 0.0001$; $F(1, 1146) = 7.43, p = 0.007$.

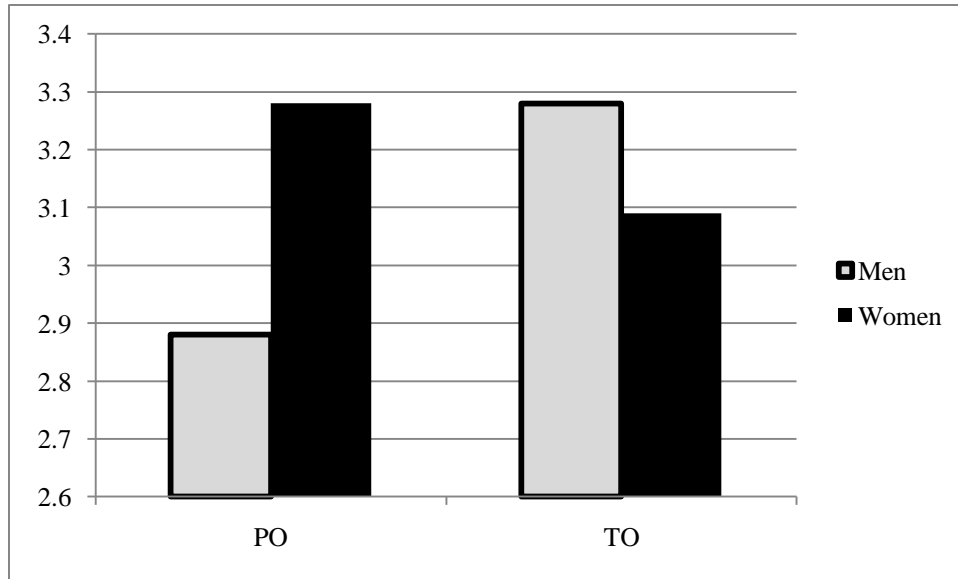


Figure 2: Mean person and thing orientation scores by sex

Interestingly, when the two groups (students in their first year and in their fourth year) are compared, it emerges that person orientation increases while thing orientation decreases (*Figure 3*). It is possible that PO increases as opportunities for socialization increase students' interest in others.

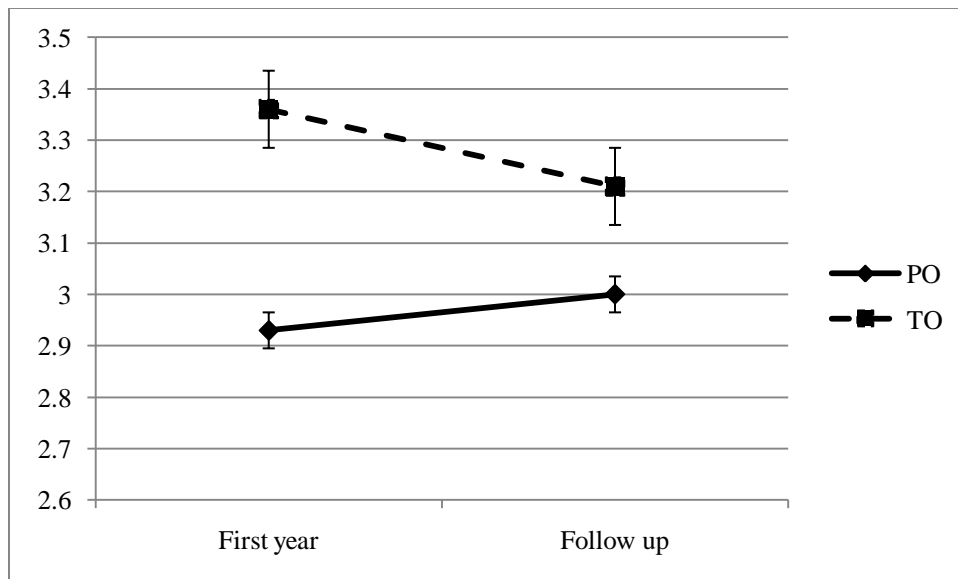


Figure 3: Aggregate change in person and thing orientation from first year to fourth year

When this aggregate data is split into men and women (*Figures 4 and 5*), it becomes apparent that TO decreases steeply in women while PO in women decreases slightly. The reasons for this observed trend thing TO require more study to explain.

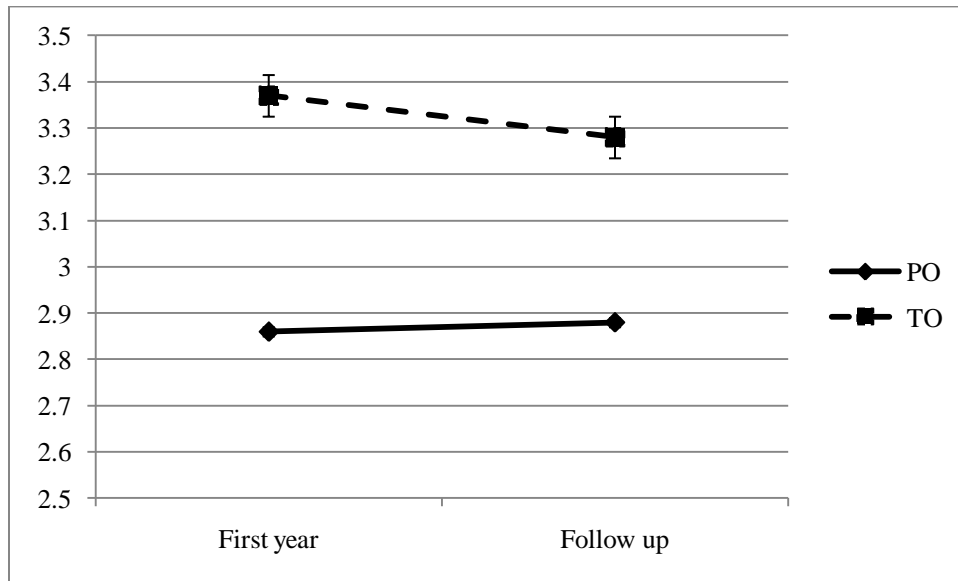


Figure 4: Aggregate change in person and thing orientation from first year to fourth year among men

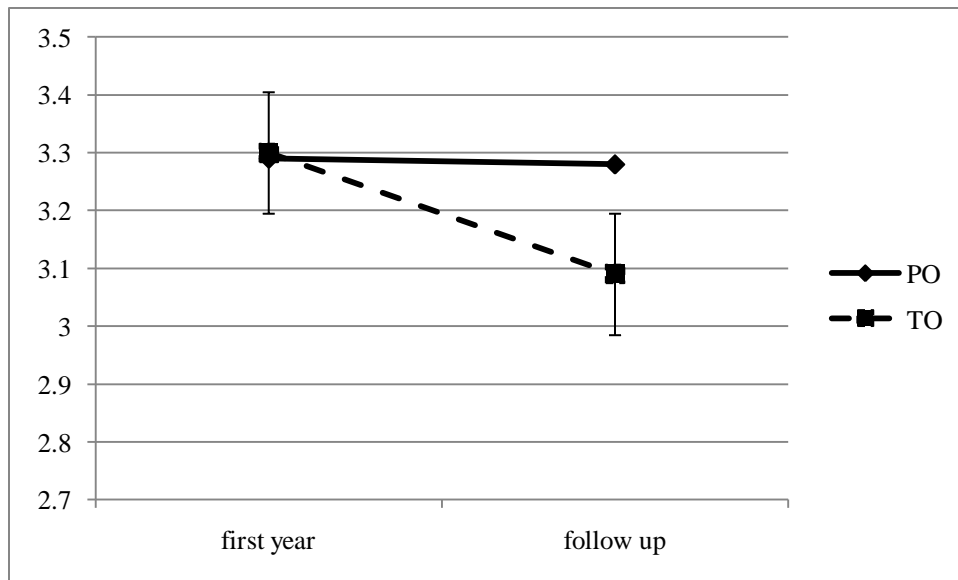


Figure 5: Aggregate change in person and thing orientation from first year to fourth year among women

The utility of PO and TO in predicting persistence in engineering was also tested. Logistic regression analysis was used to predict the probability that a first-year student would remain in engineering. The predictor variables were students' high school GPA, person orientation, thing orientation and students' sex. The model was found to be statistically significant $\chi^2 (4, N= 979) =$

32.9, $p < 0.001$. The model was able to correctly classify 87% of students' intention to stay. Table 2 shows the regression coefficients and odds ratios for each of the predictor variables in the model. Thing orientation emerged as the only significant predictor of intention to remain in engineering, indicating that students high in thing orientation are 2.5 times as likely to remain in engineering.

Table 2: Logistic regression predicting stay/leave behavior for first year engineering students

	B	Wald	<i>p</i>	Odds Ratio
Person Orientation	-.028	.024	.876	.972
Thing Orientation	.933	23.934	.000	2.543
High school GPA	.056	.226	.634	1.058
Sex	-.469	2.754	.097	.626

Multiple regression analysis was used to model the students' intention to pursue an engineering career. The predictor variables used were students' high school GPA, person orientation, thing orientation and students' sex. A significant model emerged $F(4, 246) = 6.17, p < 0.001$. Table 3 shows the predictor variables.

Table 3: Multiple regression analysis predicting pursuit of an engineering career is follow up group

Predictor variable	Beta	<i>p</i>
Person orientation	-.154	.025
Thing orientation	.283	.000
Major GPA	-.143	.019
Sex	.109	.098

Again thing orientation emerged as the only significant predictor of intention to pursue a career in engineering.

Though the results above are correlational and therefore provide no causal certainties, they do indicate that thing orientation is an important disposition in engineering.

Conclusion

Engineers are high in thing orientation and it emerges in both first year engineering students and fourth year engineering students as a significant predictor of intention to pursue an engineering major and an engineering career respectively. Given the evidence for the importance of thing orientation to persistence provided above, the observed decline in thing orientation over time may be cause for concern as it could be a contributing factor to students graduating from engineering choosing not to pursue engineering careers.

There is clear evidence of the importance of thing orientation in the motivation to choose and remain in engineering. However, as a construct, thing orientation has not been extensively studied and is not well understood. Further research is needed to confirm the role that thing orientation plays in career decision-making among engineering students, and to examine the mechanisms through which it acts. An improved understanding of these mechanisms will provide opportunities for engineering educators to manipulate messages and adjust support mechanisms to take advantage of thing orientation to increase engineering persistence particularly among women.

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