Journal of Information Systems Education

Winter 1994-95

An Evaluation of Factors Influencing Intentions to Major In Information Systems

ABSTRACT: The field of information systems (IS) is facing a dilemma–a decline in the number of students majoring in IS at a time when demand for IS graduates is increasing. There is therefore a need to determine ways to encourage freshmen and sophomores to consider IS as a potential major. The current research project utilized the Theory of Reasoned Action (TRA) to determine what factors influence undergraduate business students to consider a major in IS. The results from a sample of 169 undergraduates on a number of variables are reported. TRA was found to be valid in this context, and several useful recommendations are made in terms of what can be done to encourage students to select a major in IS at the undergraduate level.

Jonathan K. Trower
G.W. K. Willis
Dovalee Dorsett
Information Systems Department
P.O. Box 98005
Baylor University Waco, Texas 76798-8005
1-817-755-2258

KEYWORDS: *Theory of Reasoned Action, Information Systems Education, Undergraduate Students*

INTRODUCTION

The field of information systems is facing a dilemma– the demand for programmers and analysts is increasing [7, 10, 13], while the number of students interested in majoring in information systems while in college is decreasing [5]. This downward trend in interest in information systems has been occurring since 1982, when a high of 8.8% of college freshmen indicated an interest in programmer/analyst occupations, to a much lower percentage of 2.6% in 1989 [2,3].

As the gap between supply and demand for IS graduates widens, the impact will be felt in several ways within organizations. For example, maintenance of existing systems is an increasing burden in most organizations [12]. Without a steady supply of IS graduates, maintenance of these systems could be delayed. Furthermore, as organizations identify new systems critical to their mission, the shortage of qualified IS personnel will cause a delay in the implementation of those systems, thereby costing the organization the potential benefits of the new systems [14].

Given the likely impact of this shortage on organizations, many efforts have been undertaken to reverse the trend away from the computer field among college students. For example, Mawhinney and Miller [8] studied the impact that an educational video concerning the IS profession would have on perceptions about the field among high school seniors. The purpose of this research project was to explore the factors that lead some undergraduate business students to choose a major in IS, thus giving guidance for possible changes to those responsible for the development and promotion of such programs.

RESEARCH QUESTION

Given the increasing need for IS graduates and the declining interest on the part of undergraduates to major in this field, we were interested in exploring the following question: What are some of the factors that lead an undergraduate business student to choose to major in IS? Furthermore, we were interested in some of the perceptions students have of a career in IS, and whether those perceptions differ for those who major in IS versus those who do not. The ultimate goal of the research is to determine if there is some way to encourage more students to consider a major in IS to help meet projected future demand for IS employees.

Several different approaches could have been taken to address the research questions presented above. For example, we could have sampled graduating senior students both in IS and in other functional areas to assess their perceptions. However, given our focus on why students major in IS, we chose to focus on students who were in the process of choosing a major (primarily sophomores) to determine the perceptions they have as they go through the process of selecting a major.

Since our subjects were in the process of deciding their major, we could not measure their actual behavior in terms of academic major[1]. At this point in their academic career, all we could measure is their intent to major in IS. However, Fishbein and Azjen's Theory of Reasoned Action (TRA) provides a useful theoretical framework for relating these intentions to actual behaviors [1, 6]. Furthermore, it looks at the antecedents to those intentions so that we can examine several factors that may influence those intentions.

THEORY OF REASONED ACTION (TRA)

According to TRA [1,6], the single best predictor of actual behavior is a person's intention to perform that behavior (Figure

[1]*Of course, we could have conducted a longitudinal study where intentions were measured in year 1 and actual behavior in year 3. However, this study was more focused on ways to get students to consider IS as a potential major and less on the actual behavior ultimately exhibitied by the subject in our study.*

1). The person's intentions (I) are determined jointly by his or her attitude (A) and subjective norm (SN) concerning the behavior in question. The attitude component refers to the person's positive or negative attitude (evaluative affect) concerning the behavior in question. An individual's subjective norm is the perception that most people who are important to him think he should or should not perform the behavior in question [1, p.57]. This relationship can be shown by the following regression equation:

$$I = w_1 * A + w_2 * SN$$

TRA further states that the attitudes a person has concerning a particular behavior (A) are influenced by salient beliefs (b_i) about the outcomes of performing the behavior and the evaluation (e_i) of the desirability of those consequences. The salient beliefs are the individual's belief that performing a given behavior will lead to a particular outcome. This relationship can be shown by the following function:

$$A = \Sigma\, b_i * e_i$$

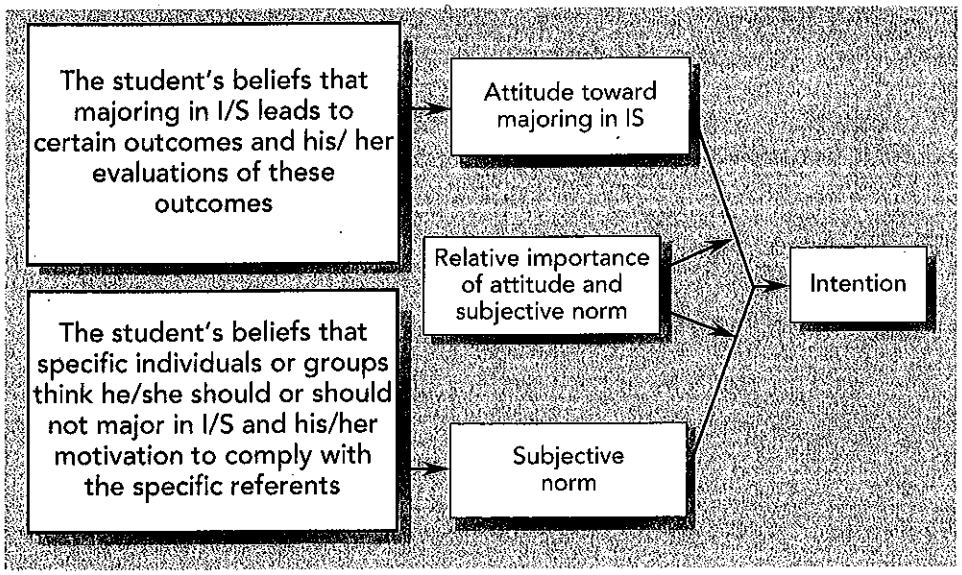
Finally, TRA provides a predictive link between an individual s subjective norm (SN) and both their normative beliefs (nb_i) and motivation to comply (mc_i). Their normative beliefs are a subjective evaluation of whether significant individuals in their life feel they should perform the target behavior; the motivation to comply is an evaluation of whether the individual subject feels compelled to comply with the expectations of those significant others. SN is determined by the following function:

$$SN = \Sigma\, nb_i * mc_i$$

Sheppard, Hartwick and Warshaw [11] recently conducted a meta-analysis of the research involving TRA to date. They found "strong overall evidence for the predictive utility of the model" (p. 325), even when boundary conditions initially placed on the theory by Fishbein and Ajzen were violated. In 87 studies involving a total of 12,624 subjects that investigated the relationship between attitudes and subjective norms and intentions, Sheppard et al. found an average multiple correlation of 0.66, significant at the .001 level. For the relationship between intentions and behaviors, they found an average multiple correlation of .53 (based on 87 studies involving a total of 11,566 subjects).

This correlation is significant at the .01 level. Thus, based on these meta-analytic results, we can assume the efficacy of TRA for use in the present study.

Figure 1. THEORY OF REASONED ACTION



RESEARCH DESIGN

This research was conducted utilizing a survey instrument to elicit responses from a group of university students enrolled in a sophomore-level introductory business statistics course[2]. Use of students as subjects is clearly justified in this case, since the intentions of undergraduate students to major in IS is the dependent variable we wish to predict.

Following development, the questionnaire was pretested prior to use in the actual study. Results of the pretest failed to indicate any problems with the instrument. After the data collection effort, the instrument was then factor-analyzed to validate the various scales. Finally, comparisons were made between students who indicated an intention to major in IS versus those who did not have that intention.

QUESTIONNAIRE DEVELOPMENT AND VALIDATION

Questionnaire development followed the guidelines set forth by Ajzen and Fishbein [1]. The salient beliefs concerning majoring in IS were elicited from a group of 17 students who were enrolled in an advanced COBOL programming course at the time, as well as a group of 337 freshmen enrolled in an introductory computer literacy course. The salient beliefs concerning a major in IS that were derived from this sample included the following:

Majoring in IS

- will prepare me for a possible career in consulting
- may make my college background too technical
- will prepare me for a high paying job
- does not make sense when a more technical alternative may exist
- will provide me ample opportunities to find a job upon graduation
- will allow me to acquire a strong foundation in information and how it is used in organizations
- will place me in a field where the technology is rapidly changing, resulting in obsolescence of my knowledge
- will prepare me to graduate with a skill
- will prepare me to become a part of a dynamic field
- will prepare me for a field that provides a balance between technical and business skills
- will place me in a field of study where I like the professors

The list of salient referents was determined only from the group of 17 COBOL students who were actually majoring in IS. The salient referents mentioned by the COBOL students included their parents, other relatives, close friends, current or former boss, IS professors, and non-IS professors.

The entire questionnaire is shown in the Appendix. The instrument was pilot-tested in a single class of 12 students from the target population. No problems were evident from this small administration of the questionnaire. Therefore, data collection proceeded in other sections of the

[2] *It is possible that some upper-classmen who had already declared their major were included in this sample. However, if this is the case, it should not weaken the results. Even if the behavior is already exhibitied (majoring in IS), the individual must continue to intend to exhibit that behavior.*

Table 1. SCALE RELIABILITIES

Scale	Cronbachis Alpha	Number of Items
Attitudes	.81	4
Outcome Evaluations	.70	8
Behavioral Beliefs	.82	8
Normative Beliefs	.89	6
Motivation to Comply	.91	6

Table 2. SAMPLE DEMOGRAPHICS

Gender

46.7% Female
53.3% Male

Age

Mean =20.62
Stdev =2.95

Grade Classification

1.8% Freshman
57.4% Sophomore
29.0% Junior
11.2% Senior
0.6% Other

Months of Full-Time Work Experience Since High School

Mean = 9.15
Stdev = 20.08

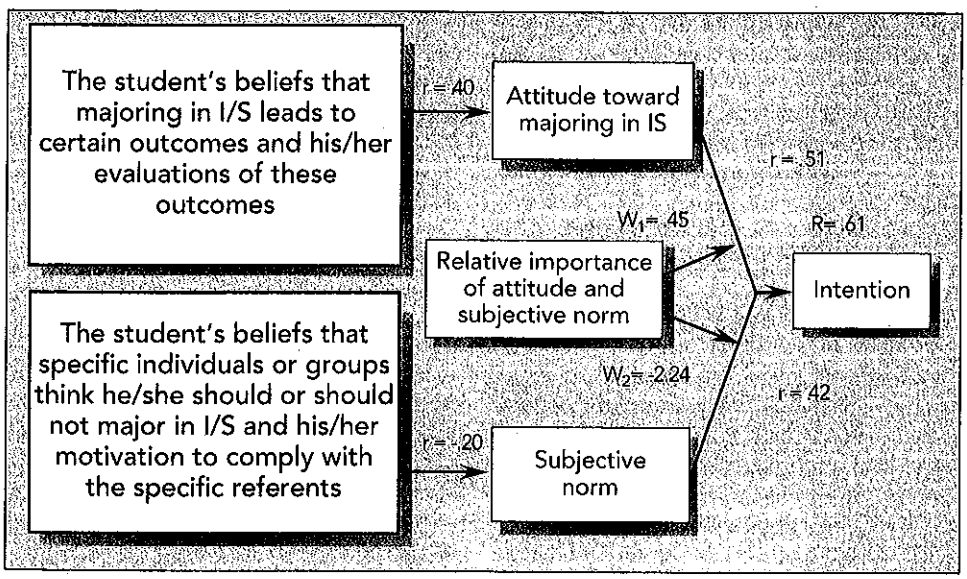
Months of Full-Time Work Experience Since High School Involving Computers and Other Forms of Information Technology

Mean = 4.99
Stdev = 18.42

Computer Programming Experience
(1=No Experience, 5=Extensive Experience)

Mean = 1.68
Stdev = .47

Figure 2. REGRESSION RESULTS FROM CURRENT STUDY



target course with a final sample size of 169 respondents.

Following the data collection, the factor structure and reliability of each scale was assessed. All items on each scale loaded on a single factor,[3] with the exception of the outcome evaluations and the behavioral beliefs scales. On both scales there were three questions dealing with technical aspects of a job in IS. These questions (5, 7, 10, 16, 18, and 21) failed to load on the primary factor in both cases. It is possible that students at this early point in their school career could not adequately judge the technical aspects of a job in IS. These questions were therefore dropped from further consideration.

The scale reliabilities, after dropping the six questions mentioned above, are shown in Table 1. While the reliability of the outcome evaluations scale is not as high as desired, it does meet the minimum criteria set by Nunnally [9].

SAMPLE

The subjects in this study were undergraduates at a major university in the southwest region of the United States. All students were enrolled in a sophomore-level introductory statistics course required for admission to the university's business school. None of the respondents were in sections of this course taught by any of the authors. A prerequisite for this course is an introductory computer literacy course taught by IS faculty members in the business school. Thus, all subjects had been exposed to some IS fundamentals and the concept of a career in a computer-related field. The vast majority of the students had not progressed to the point in their academic career where they has formally declared their major. Thus, at the point in time when the data was collected, actual behavior in the form of declared majors was not obtainable.

Descriptive statistics describing the sample are provided in Table 2. There are no statistically significant differences between those who intend to major in IS and those who do not for any of the demographic variables at the .05 level. The values for age and full-time work experience are skewed somewhat by a couple of middle-age students in the sample. Given the goal of this research, however, there was no theoretical justification for excluding those individuals from the sample.

RESULTS

Data analysis was first attempted utilizing normal multiple regression techniques similar to those applied in previous studies involving TRA. Due to a problem with the normality of the residuals in our analysis, a Box-Cox transformation was performed, resulting in the transformation of the dependent variable to the square of y. The results from this analysis are shown in Figure 2, again following the normal conventions used in prior TRA research. All

[3] *All factor analyses were performed utilizing varimax rotation and a minimum eigenvalue of 1.0. All factor loadings were .40 or higher.*

correlations shown in Figure 2 are significant at the .01 level or better. The overall regression model relating the subjective norms and attitude toward majoring in IS to intentions to major in IS was significant at the .0001 level. The value for *R* (the multiple correlation coefficient) of .61 is very similar to that reported in the meta-analysis by Sheppard et al.[11], further strengthening our belief that TRA is a useful approach to the current research question.

While an analysis similar to the one above is frequently utilized in TRA research, the authors felt that given the ordinal nature of the independent variables and the nominal nature of the dependent variable, a more appropriate statistical approach, logistic regression, should be used that does not assume interval measurement scales. In this approach, two levels of the dependent variable were used–one for those who did intend, to some extent, to major in IS; the other for those who expressed no intention of majoring in IS. Based on the results of the logistic regression, we concluded that the combined effect of attitude and subjective norms is significant with a *p*-value of .0001.

Since these results are similar to those from regression, it further strengthens our conclusion that TRA is applicable to this research question.

Ajzen and Fishbein [1] suggest that external variables may be related to intentions and behavior, but only indirectly through the influence the external variables would have on beliefs and attitudes. In developing this research project, we hypothesized that five different external variables–job market perceptions for IS graduates, gender, age, number of months of full-time work, and the number of computer languages known–would impact intentions to major in IS. The hypothesized external variables are shown in Figure 3.

Given the introduction of the demographic variables in Figure 3, we needed an analysis technique that simultaneously analyzed the entire model. Such an analysis is possible with linear structural equation modeling, which is commonly implemented through the use of a program such as LISREL, although algorithms for performing this analysis have been implemented in a number of other programs, including SAS. Because of its availability, and the ease by which we could obtain assessments of fit, we chose to use PROC CALIS in SAS for our analysis in this study.

We proceeded with our analysis as follows: first, we analyzed Fishbein and Ajzen s

Figure 3. STRUCTURAL EQUATION MODEL

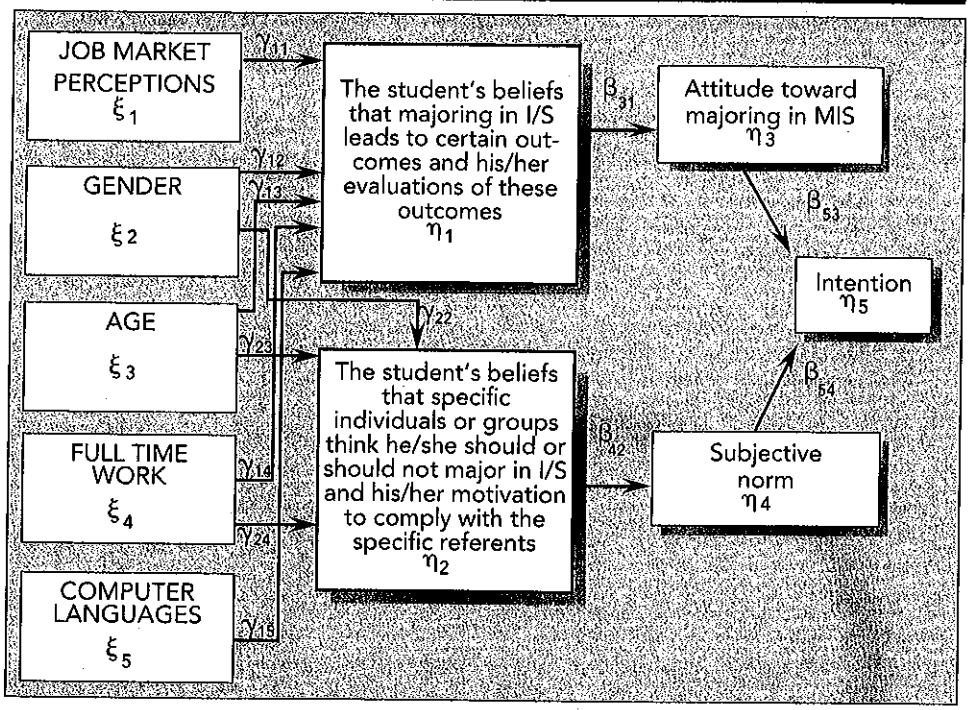
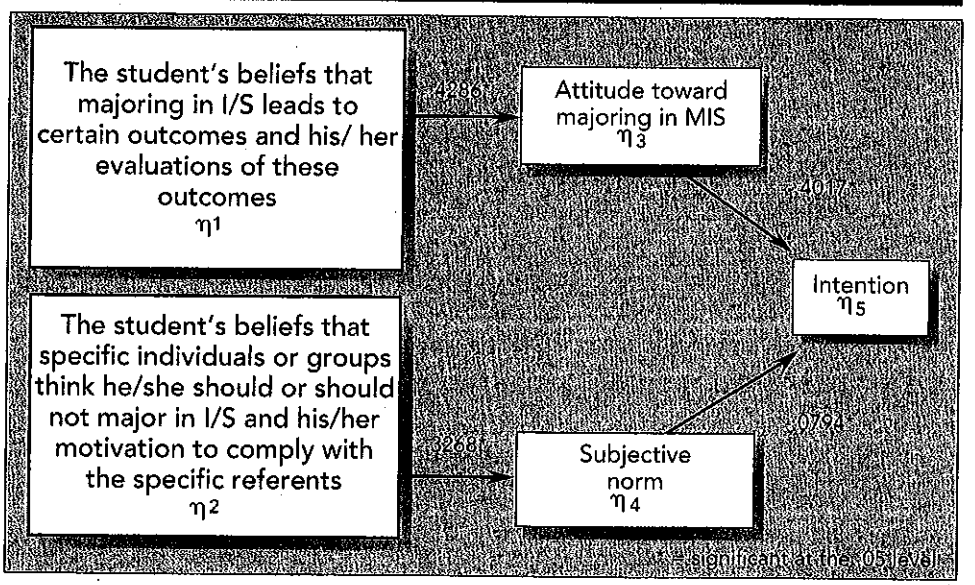


Figure 4. RESULTS FROM STRUCTURAL EQUATION MODELLING OF MODEL 1



original model (Figure 1); second, we tested our proposed extension of the model shown in Figure 3. By comparing the fit between the analysis of Figures 1 and 3, we can determine if the demographic variables add to our understanding of a college student's intentions to major in information systems. Since there is not one single measure of goodness-of-fit that is agreed to by those who use structural equation modeling, we report several different measures, including the p value associated with the chi-square statistic, the adjusted goodness-of-fit index (AGFI), and Bentler and Bonett's [4] normed index. In interpreting these statistics, it is desirable to have an insignificant *p* value for the chi-square statistic; a significant p value indicates that the model does not fit the dataset. However, this test is sensitive to the overall sample size, and therefore it is usually accompanied by fit indices that are not affected by sample size. AGFI and Bentler and Bonett's normed index range from zero to one, with numbers closer to

Table 3. COMPARISON OF THOSE INTENDING TO MAJOR IN IS VERSUS THOSE NOT INTENDING TO MAJOR IN I.S.

	Average for Those Who Intend to Major (n=31)	Average for Those Who Do NOT Intend to Major (n=139)	p-value*
Attitudes (Majoring in IS is...)			
Good-Bad	2.13	-.11	.0001
Rewarding-Punishing	1.94	.19	.0001
Pleasant-Unpleasant	1.13	.11	.0005
Wise-Foolish	2.16	.58	.0001
Outcome Evaluations (Majoring in a field that will provide _____is good.)			
Possible career in consulting	1.52	1.16	.1373
High paying job	2.55	2.39	.3871
Ample job opportunities upon graduation	2.74	2.64	.8349
Strong foundation in information and how it is used	2.55	2.04	.0018
Graduating with a skill	2.65	2.26	.0253
Preparing to become part of a dynamic field	2.26	2.07	.5862
Balance between technical and business skills	2.29	1.70	.0035
Liking the professors	1.97	1.90	.8208
Behavioral Beliefs (Majoring in IS will provide...)			
Possible career in consulting	1.16	.63	.0473
High paying job	1.81	1.08	.0001
Ample job opportunities upon graduation	1.90	.99	.0001
Strong foundation in information and how it is used	1.90	1.62	.1964
Graduating with a skill	2.45	1.78	.0002
Preparing to become part of a dynamic field	2.00	1.63	.0465
Balance between technical and business skills	1.90	1.28	.0066
Liking the professors	1.55	.75	.0002
Subjective Norm (Those who are important to me think I should major in IS)	.32	-1.15	.0001
Normative Beliefs (My____think I should major in IS)			
Parents	.58	-1.42	.0001
Other relatives	.19	-1.47	.0001
Close friends	.16	-1.37	.0001
Current/former boss	.10	-1.28	.0001
MIS professors	.81	.07	.0849
Non-MIS professors	.32	-1.04	.0001
Motivation to Comply (Generally speaking, I do what my _____ think I should do.)			
Parents	-.52	-.20	.3615
Other relatives	-1.35	-.91	.1439
Close friends	-1.19	-.96	.3779
Current/former boss	-.97	-1.02	.8462
MIS professors	-.06	-1.04	.0004
Non-MIS professors	-.16	-.70	.0621
Job Market Perceptions			
Overall for all graduates	.48	.30	.5126
For IS graduates	1.35	.54	.0002

* From Wilcoxon rank-sum test

one indicating better fits between the model and the data. Both of these measures are not affected by the overall sample size.

Our initial analysis of the model in Figure 1 indicated that the theoretical model fit the data very well. The chi-square value of .7034 was not significant (p = .8724), AGFI = .9915, and Bentler and Bonett's normed index = .9958. In this analysis, both numbers are very close to one, indicating a very good fit between the theoretical model in Figure 1 and our dataset. The parameter estimates for this analysis are shown in Figure 4.

To test the additional effect that the demographic variables had on intentions, beyond that of attitudes and behavior, we used SAS to estimate the model shown in Figure 3. With the addition of these five new variables, the overall fit of the model went *down*, indicating that while the initial model fit the data, this revised model did not fit as well. Thus, for discussion purposes we consider only the basic theoretical model presented in Figure 1. This finding is also consistent with that obtained through correlation analysis--there were no significant correlations between the five external variables and intentions.

DISCUSSION

Given the results reported above concerning the applicability of TRA to this particular research question, we can now turn to an in-depth analysis of the differences between those who expressed an intention to major in IS versus those who do not intend to do so. The Wilcoxon rank-sum test was used to compare the responses from those who DO intend to major in IS with the responses from those who DO NOT intend to do so. The results from these tests are shown in Table 3. In this table, the higher the average, the more the respondents agreed with the statement; the smaller the number, the more they disagreed with it. All responses were on a +3 to -3 scale.[4]

It is instructive to look at those variables in Table 3 where the p-values indicate a significant difference between the two populations. For example, under outcome evaluations there were significant differences on three variables: obtaining a strong foundation in information and how it is used, graduating with a skill, and obtaining a balance between technical and business skills. In formulating a plan to encourage more individuals to consider majoring in IS as an undergraduate, one should stress that an IS major will have a skill that provides a balance between their business and technical skills. Furthermore, they will have that strong foundation in information.

[4]*The scale of +3 to -3 is standard for studies using TRA. However, since these numbers are multiplied together, it can lead to the negative numbers shown in Figures 2 and 4. An individual who is very negative on both dimensions of a construct will have a positive product, whereas another student who is positive on one and negative on the other will have a negative products.*

Under the behavioral beliefs, there are a number of variables on which those who intend to major in IS differ from those who do not. Again, each of these variables may represent areas that could be stressed in encouraging non-IS majors to consider a major in the field: possible career in consulting, a high paying job, ample job opportunities upon graduation, graduating with a skill, becoming part of a dynamic field, and having an education balanced between technical skills and general business skills. The job market perceptions were reinforced in the last set of questions listed in Table 3, where it is obvious that IS graduates were perceived to face a more positive job market than non-IS majors.

IMPLICATIONS

The goal of this research was to determine if there is some way to encourage more students to consider a major in IS. Given that the relationships in TRA were found to be significant in this sample, TRA can provide guidance in turning the results of this study into changes in the behavior of students so that more of them will consider IS as an academic major. A survey instrument similar to the one in the Appendix could be modified for use in different schools in an effort to determine what would influence a particular set of students to consider a major in IS.

According to TRA, behavioral change is the result of changes in beliefs. The implication of this is that to change behavior (to get more students to major in IS), we must expose students to information that will produce such changes in their beliefs [e.g.,5]. Given the specific results in this study, students need more information concerning all of the variables listed in Table 3 as behavior beliefs, in an effort to produce changes in their beliefs that would be sufficient to get them to consider a major in IS.

Specifically, educators in the IS area must educate freshmen and sophomore students about the job prospects for IS majors and the types of jobs for which they would qualify. Furthermore, they need to stress the fact that IS majors graduate with a marketable skill that prepares them to become part of a dynamic, interesting field that requires a balance between their technical skills and more general business skills. This information could be disseminated to students through a number of outlets: brochures, departmental newsletters, lectures in freshmen-level IS courses, ads in student newspapers, flyers on school bulletin boards, guest lecturers from industry, student reports on summer internship experiences, and non-traditional outlets such as Gopher or World Wide Web servers. At Baylor we are beginning to implement several of these suggestions, though it is too early to tell what impact they will have on the number of IS majors.

It is important to note in interpreting the results of this study that we used subjects from only one university. Therefore, the results may vary from school to school, and we encourage interested colleagues to utilize the questionnaire in the appendix to replicate this study in your own setting.

REFERENCES

1. Ajzen, I.; and Fishbein, M. *Understanding Attitudes and Predicting Social Behavior.* Englewood Cliffs, NJ: Prentice-Hall, Inc., 1980.

2. Astin, A.W.; Greene, K.C.; and Korn, W.S. *The American Freshman: Twenty Year Trends.* Los Angeles: Higher Education Research Institute, 1987.

3. Astin, A.W.; Korn, W.S.; and Berz, E.R. *The American Freshman: National Norms for Fall 1989.* Los Angeles: Higher Education Research Institute, 1989.

4. Bentler, P.M. and Bonnett, D.G. Significance Tests and Goodness of Fit in the Analysis of Covariance Structures. *Psychological Bulletin,* 88 (1980), pp. 588-606.

5. Cale, E.G.; Mawhinney, C.H.; and Callaghan, D.R. The Implications of Declining Enrollments in Undergraduate CIS Programs in the United States. *Journal of Management Information Systems,* 8 (1991), 167-181.

6. Fishbein, M.; and Ajzen, I. *Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research.* Reading, MA: Addison-Wesley, 1975.

7. Hodges, P. Three Decades by the Numbers. *Datamation,* 33, 18 (1987), pp. 77-87.

8. Mawhinney, C.H.; and Miller, G. Marketing the Information Systems Profession: A Preliminary Report on the Boston-SIM Careers Videotape. *Proceedings of the 1991 ACM SIGCPR Conference,* Athens, Georgia, April 1991, 1-2.

9. Nunnally, J.C. *Psychometric Theory,* 2nd ed. New York: McGraw-Hill, 1978.

10. Silvestri, G.T.; and Lukasiewicz, J.M. Projections 2000: A Look at Occupational Employment Trends to the Year 2000. *Monthly Labor Review,* (September 1987), 46-63.

11. Sheppard, B.H.; Hartwick, J.; and Warshaw, P.R. The Theory of Reasoned Action: A Meta-Analysis of Past Research with Recommendations for Modifications and Future Research. *Journal of Consumer Research,* 15 (1988), 325-343.

12. Swanson, E.B.; and Beath, C.M. *Maintaining Information Systems in Organizations.* New York: John Wiley & Sons, 1989.

13. *US News & World Report.* Hot Tracks in 20 Professions. November 1, 1993, 106-112.

14. Zeltmann, S.M.; Parzinger, M.J.; and Vineyard, M.L. Solutions for Computer Software Maintenance Problems? In Khosrowpour, M., ed. *Managing Information Technology in a Global Society,* Harrisburg, PA: Idea Group Publishing, 1991.

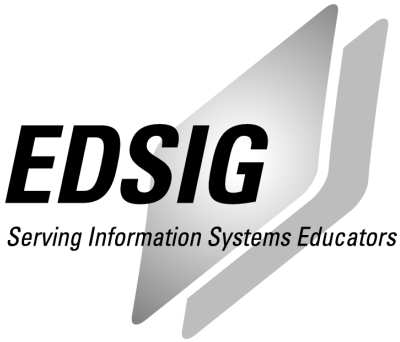
Authors' Biographies

Jonathan Trower is an assistant professor of Management Information Systems at Baylor University. He received his Ph.D. from the University of Minnesota. Dr. Trower's research interests are primarily in the area of IS personnel, including motivation, performance assessment, selection, and retention.

G. W. Willis is professor and chairman of the Information Systems Department in the Hankamer School of Business at Baylor University. He received his Ph.D. from Texas A&M University, and served as director of Casey Computer Center at Baylor and the Data Processing Center at Texas A&M. His work experience and research interests focus on information systems development, reengineering, client/server applications, and internal controls.

Dovalee Dorsett is an Associate Professor of Quantitative Business Analysis in the Department of Information Systems at Baylor University. She received her Ph.D. in Statistics from Southern Methodist University. Dr. Dorsett's research include linear models, time series, and statistical process control.

Information Systems & Computing
Academic Professionals



STATEMENT OF PEER REVIEW INTEGRITY

All papers published in the Journal of Information Systems Education have undergone rigorous peer review. This includes an initial editor screening and double-blind refereeing by three or more expert referees.

ISSN 1055-3096