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ABSTRACT

This study investigated the ability of student inputs, student involvements, and college environments to predict seven groups of academic majors. The research was conducted using a sample of college sophomores extracted from High School and Beyond 1982 follow-up cohort, N=43,614 (weighted). Among the findings of the hierarchical discriminant function analysis was that the combined effects of the three blocks of variables appeared to be the most effective model. Implications of the results for practice, theory, and research are discussed. The study considered the following inputs: race, gender, high school course work, proposed field of study in college, highest degree expected, academic ability, family background, and personality factors. Involvement indicators were: type and degree of involvement in college activities; course work completed in college; importance of success, money, friends, work, and children; family orientation; and community orientation. Environments comprised: indexes of satisfaction with college facilities; faculty; curriculum; cultural and intellectual life; sports and recreation; social life; counseling and job placement; financial cost; prestige; and institution type, public vs. private. (Contains 20 references.) (MAH)

Student Input, Student Involvement, and College Environment Factors Impacting the Choice of Academic Major

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Abstract

Using the Astin model for assessment this study investigated the ability of student inputs, student involvements, and college environments to predict seven groups of academic majors. The research was conducted using a sample of college sophomores extracted from High School and Beyond, N=43,614 (weighted). Among the findings of the hierarchical discriminant function analysis is evidence that the combined effects of the three blocks of variables is the most effective model. At this step 86.7% of the cases were correctly classified accounting for 75% of the variance among majors. Implications of the results for practice, theory and research are discussed

Student Input, Student Involvement, and College Environment Factors Impacting the Choice of Academic Major

Gottfredson & Holland (1975) report that 72% of the women in a liberal arts college and 62% of the women in a state university were leaning towards occupations classified as social in nature. The observed trends may well have been a reflection of gender norms permeating the culture of the 1970s. McJamerson (1990) reports that a continuing and disproportionately low number of women and non-Asian minorities are selecting the sciences and other technical fields as majors. Currently several areas of study are under represented, regardless of demographics. Astin (1993) reports a significant decline in freshman career choices over time (1985 vs. 1968) for school teaching (6.0% vs. 23%); college teaching (0.3% vs. 1.2%) and scientific research (1.9% vs. 3.1%). The American Council on Higher Education and the University of California at Los Angeles Higher Education Research Institute (1994) report the results of their annual survey of college freshmen. In 1993, 5.6% of the students surveyed selected the biological sciences as a probable academic major; 2.5% chose the physical sciences; and 2.94% chose other technical fields. Collison (1993) reports that since 1987, there has been a 10% decline in the number of students interested in a major in business since and a 3% increase in majors related to the health professions.

In an ideal world one could expect that these selections were based upon informed choice; a blend of interests, abilities, and economic considerations. In reality, other issues impact this decision and little is known about how these potential influences operate and only a handful of studies which treat academic major as an outcome variable.

Congruent with the assumptions of Astin's (1991, 1993) I-E-O model, this study assesses student input, student involvement, college environment, and the outcome, academic major. The current study considers inputs (race, gender, high school course work, proposed field of study in college, highest degree expected, academic ability, family background, and personality factors), involvement indicators (type and degree of involvement in college activities; course work completed in college; importance of success, money, friends, work, and children; family orientation, and community orientation), and environments (indexes of satisfaction with college facilities, faculty, curriculum, cultural and intellectual life, sports and recreation, social life, counseling and job placement, and financial cost and prestige, institution type -- public vs. private) which potentially influence the outcome of choice of academic major. A composite listing of these three blocks of independent variables selected for analysis are provided at Tables 1, 2, and 3.

[Insert Tables 1, 2, and 3 about here]

Method

Participants

The sample for this study was extracted from the 1982 follow-up cohort of High School and Beyond (HSB) developed under the auspices of the National Center for Education Statistics (NCES). It includes those students who were high school seniors in 1980, participated in both the base year data collection and the 1982 follow-up, reported that they were seeking a Bachelors Degree with a declared major, and were college sophomores by February 1982.

Case weights, based on the participant status of respondents are included in the HSB data base and were developed to account for the disproportionate sampling of certain sub-groups in the HSB. Prior to analysis FUWT1, the weight for each case, was divided by the mean estimated design effect of 2.195 (Spencer, Sebring & Campbell, 1987). The resulting figure became the weight variable.

The valid sample size for this study, with weighting utilized, is 43,614. However, BMDP7M, the statistical program of choice for the analysis, does not allow for weighting when discriminant analysis is used. As such, SAS, another statistical program, was used to replicate each case X number of times (where X is equal to FU1WT/2.195) and create an actual data set before running BMDP7M.

Dependent Variable

Academic Major was defined as the academic major students identified while sophomores in college in response to the NCES survey. Majors were further classified to parallel, as much as possible, the five clusters identified by Jackson and Others (1981) and Jackson et al. (1984): (1) Physical, Biological Sciences, and Health Sciences, Mathematics, and Engineering, weighted N=13047, (2) Education, Home Economics, Ethnic Studies, Social Sciences, Music, Psychology, Communications, English, Foreign Languages, and Philosophy/Religion, weighted N=14169, (3) Agriculture, weighted N=1005, (4) Art and Architecture, weighted N=2170, and (6) Business, weighted N=10163, accounting for 21 of 25 possible choices identified in the HSB data set. Two other criterion groups were included but considered as unique clusters having no known parallel to the classification scheme employed: (5) Health Occupations, weighted N=1619, and (7) Preprofessional, weighted N=1441. The HSB category of other, a write-in response to the survey, is not further defined by the data base, and subsequently omitted from this study. The HSB category of Interdisciplinary includes only three students who meet the selection criteria, and was subsequently omitted from this study.

Design and Procedure

A multiple discriminant function analysis was conducted using three models (blocks of independent variables) to predict group membership in the seven categories of one dependent variable, academic major. Block 1 included student inputs; Block 2, student involvement indicators; and Block 3, college environment indicators The hierarchical design allowed for an assessment of the improved ability of the discriminant function equation to predict group membership with the additive entrance of each successive block.

The utility of the predictor variables was checked using ANCOVA procedures. Differences among majors were found for each variable above and beyond the effects of other variables within the same block and variables from previous blocks. Prior probabilities of group membership were established based on the valid percent of individuals within each major. Assumptions normally associated with discriminant function analysis were tested and necessary adjustments made prior to the analyses (Tabachnick & Fidell, 1993).

Results

Models 1 - 3, taken together (see Table 4) illustrate the extent and manner in which each block of variables is able to predict group membership as students select majors.

Model 1

Model 1 revealed the relative effectiveness of student inputs as a predictor of academic major. This model correctly classified 69.9% of the cases and its best function accounted for 61% of the total variance among majors.

[Insert Table 4 about here]

Model 2

Model 2 confirmed the relative effectiveness of the block of student involvement indicators as a predictor of academic major above and beyond the effects of student inputs. The model's effectiveness was substantially better than that of Models 1, and especially for Groups 5 and 7, as indicated by the percent of cases classified correctly and the significance of the change score. The best function accounted for 72% of the total variance among majors.

Model 3

Model 3 confirmed the relative effectiveness of the block of college environments to predict academic major above and beyond the effects of the blocks of student inputs and student involvement indicators. The model's effectiveness was better than that of Models 1 and 2 as indicated by the significant increase in the percentage of cases classified correctly. The best function accounted for 75% of the total variance among majors.

Model 3 also provided evidence supporting the use of the Astin (1991, 1993) I-E-O composite to better understand factors impacting the choice of an academic major by traditional college students in their sophomore year of college. In this study Model

3 was able to correctly classify 86.7% of the sampled cases (Art/Architect 94%, Health Occ 90.9%, Lib Arts/Educ 89.6%, Sci/Eng/Math 88.9%, Preprofessional 81.1%, Business 80.0%, Agriculture 71.8%).

The Wilk's lambda (1 - R^2) for all six functions of Model 3 was 0.0100028. The best two functions of Model 3 captured nearly all of that variation among majors (99%). Therefore, plotting the group centroids for the best two functions of the model allowed for a relatively accurate, two-dimensional representation of the total model's ability to discriminate among majors.

Figure 1 shows that for the first function, Groups 2 and 4 are clearly separated from Groups 1, 3, 5, and 7 with Group 6 (Business) falling somewhere in the middle. For the second function all groups tended to be closer together except for Group 6. However Groups 2 and 4 were still clearly separated from Groups 1, 3, 5, and 7.

[Insert Figure 1 about here]

Discussion

From the perspective of this current study, Model 3 provided evidence supporting the use of the Astin (1991, 1993) I-E-O composite to better understand choice of major. It appears that the combination of academic ability, student inputs, and college environment indicators provide the best model for prediction of academic major.

Discussion of individual predictor variables within each block is limited. It can not be said with any certainty that these are the most useful variables in predicting academic major. First of all, predictors are usually correlated with each other and, as such, there is no way to unambiguously determine the importance of individual variables. With a different sample, a previously important variable may become unimportant.

Second is the potential for specification errors. LOC and SE, for example, remained in the analysis even though they accounted for no more then one percent of the variance among majors and their addition as a predictors results in no significant change in classification ability (Coperthwaite, 1994). The effects of peer group (Astin, 1993), not directly measured by HSB, and high school attended (Marsh, 1989) were omitted from the analysis as well as other variables not previously considered.

Third is the possibility of measurement problems with respect to many of the independent variables, for example, LOC and SE. The reliability coefficient alpha for the valid sample with respect to LOC was .46, very low, and for SE .73, only moderate, which could also affect validity.

A tentative sense of relative importance can be ascertained by checking the F to Remove Values for each variable at the point of the full model (Model 3). Examination of the F to Remove Values indicated that only four variables would have remained in the equation if predictors had not been forced to enter. These were: (1) projected major: Sci/Eng/Math, (2) projected major: Business, (3) years of course work since high school in science, and (4) years of course work since high school in business and sales). The results of the current study are constrained by the methodology used.

Finally, there is the problem of temporal sequencing of variables (Bachman & O'Malley, 1977). The study assumed that inputs, involvements, and environments influence choice of major. Is this the case, or does choice of major determine involvement and environment?

Even given the limitations noted previously, the study does afford students, faculty, and administrators a better understanding of the selection process, thus enabling more informed advisement and choice. Most important is the additional evidence that what students bring to college, their involvement while a student of that college, and the campus environment itself, in combination, impact the selection of an academic major, at least for some students. As reported, cases correctly classified increased from 69.9% for student inputs alone, to 84.0% with the additive entrance of student involvements, to 86.7% with the additive entrance of college environments. The impact of individual variables was not clear and the effect of their sum total is considered more important. It was the cumulative model, Model 3, that produced the best results.

Chickering (1969, 1981) claimed that student development is a result of multiple college influences. Tinto (1987) suggested that the interaction of inputs, involvement, and environment shape goals and determine retention. Pascarella (cited in Terenzini, Springer, & Pascarella, 1994) in a 1989 study of gains in critical thinking, demonstrated that a cumulative measure of social and academic involvement was far more important than any of nine individual item measures. Pascarella and Terenzini (1991) criticized the vast majority of research they reviewed concerning the impact of college experiences. They argued that consideration of relevant factors, independent of one another, is inappropriate methodology. The Astin (1991, 1993) model captured those sentiments, provided the framework for this study, and the results supported this decision.

Being able to predict the major students will choose from, some understanding of who our students are, what our students do, and what our campuses are all about, enables resources to be focused appropriately. Specific examples, although certainly not all inclusive, include facilities, personnel, faculty, course offerings, and advisement. If, hypothetically, 90% of our freshmen class claimed that they are likely to major in science, engineering, or math and, as this study suggested, we can reasonably predict that 75% of those who projected this outcome will follow through with it, would we not plan for new faculty hires, course offerings, student services, and space allocation primarily in support of science, engineering, and math perhaps above the needs and desires of other academic departments?

The National Center for Education Statistics (1993) reported an increase in the percentage of students taking more than six years to complete their degree, while the percentage graduating in four years has declined. This was recently reaffirmed at a southeastern regional university where only five percent of the 1992 graduating class received degrees within exactly four years. These results were from a university with a predominantly full-time, 18 to 22 year-old student population, much like the sample used for the current study.

It is unknown why these students took longer to complete degree requirements than the traditional four years and there are a number of potential reasons, but the impact of changing majors and therefore needing additional course work to meet requirements was a reported possibility. Perhaps too, specific courses were simply not offered when needed or not offered in sufficient quantity (Knight, 1993).

Instead of advising new freshmen to take courses based primarily on the interests they initially bring to campus, the results of this study suggest that we encourage new experiences in terms of class selection and quality involvement with the campus environment. These activities, above and beyond what students bring to campus, should maximize the ability to make an appropriate choice of major. Some of the most important issues currently being confronted by higher education involve the constraints imposed by resources and issues of accountability. To that end, any ability we have to predict what students on our campuses will do, coupled with a commitment to use that knowledge in our planning and implementation processes, should enable improvement in programs and services (involvement opportunities) and the overall academic climate (college environment) thus leading to an increase in student learning and satisfaction. This study served to further that capability. Such knowledge can only help us to foster an environment that offers students the best possible opportunity for growth in those areas for which higher education is being held accountable.

The challenge in future research concerning this topic will be to attempt to untangle the myriad of direct, indirect, and total effects involved in the selection process and to further specify those involvements with the college environment that can truly make a difference for students in order for practitioners to target their efforts accordingly, perhaps through qualitative study. This is especially important given issues of accountability and limited resources.

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Table 1

Student Input Variables

Variable	Description
Ability	Academic ability composite
Race	Black, White, American Indian, Asian/Pacific Islander, Other
Gender	Female, Male
EB004A	Years of course work, 10th- 12th grade, mathematics
EB004B	Years of course work, 10th-12th grade, English/lit
EB004F	Years of course work, 10th-12th grade, history/social science
EB004G	Years of course work, 10th-12th grade, science
EB004H	Years of course work, 10th-12th grade, business
Projdeg	Projected degree
Projmaj	Projected major
Fefamily	Family involvement composite
Fecommun	Community involvement composite
Socioeco	Socioeconomic status composite
LOC	Locus of control composite
SE	Self esteem composite

NOTE: Responses to EB004A-EB004H = None, 1/2, 1, 1 1/2, 2, 2 1/2, 3, More than Three

Table 2

Student Involvement Variables

Variable	Description
FE42A	Years of course work since high school, math
FE42B	Years of course work since high school, English
FE42C	Years of course work since high school, non-Eng language
FE42D	Years of course work since high school, hist/soc
FE42E	Years of course work since high school, science
FE42F	Years of course work since high school,bus/sales
FE74B	Participated since high school,church activities
FE74C	Participated since high school,sorority/fratern
FE74D	Participated since high school,social/hobby club
FE74E	Participated since high school,sports team/club
FE74F	Participated since high school,lit/art group
FE74G	Participated since high school,student govt/paper
FE74H	Participated since high school,drama/theater
FE74I	Participated since high school,orch/band/chorus
FE74K	Participated since high school,other volunteer
FE85A	Importance of being successful in work
FE85C	Importance of having lots of money
FE85D	Importance of strong friendships
FE85E	Importance of being able to find steady work
FE85I	Importance of getting away from this area
FE85K	Importance of having children
FE85L	Importance of having leisure time

NOTE: Responses to FE42A-FE42F = None, 1/2, 1, 1 1/2, 2, 2 1/2 or More
Responses to FE74B-FE74K = Active Participant, Member Only, Not At All
Responses to FE85A-FE85L = Not Important, Somewhat Important, Very Important

Table 3

College Environment Variables

Variable	Description
FE40A	Satisfaction with ability etc of teachers
FE40B	Satisfaction with social life
FE40C	Satisfaction with development of work skills
FE40D	Satisfaction with intellectual growth
FE40F	Satisfaction with bldgs/library/equipment/etc
FE40G	Satisfaction with cultural activities/music/art/etc
FE40H	Satisfaction with intellectual life of school
FE40I	Satisfaction with course curriculum
FE40J	Satisfaction with quality of instruction
FE40K	Satisfaction with sports & recreation facilities
FE40L	Satisfaction with financial cost of attending
FE40M	Satisfaction with prestige of the school
INSTTYPE	4 year public or 4 year private

NOTE: Responses to FE40A-FE40M = Very Satisfied, Somewhat Satisfied, Neutral, Somewhat Dissatisfied, Very Dissatisfied

Table 4

Discriminant Function Results for Model 1

Statistic	Value
Wilk's lambda	0.0678626*
Degrees of Freedom	6, 43607
F Statistic	1129.515*
Degrees of Freedom	132, 253501.56
% Cases Classified Correctly	69.9
Canonical R (Best Function)	0.77935
R^2	.61
Eigenvalue (Best Function)	1.54699
% Dispersion (Best Function)	41

Discriminant Function Results for Model 2

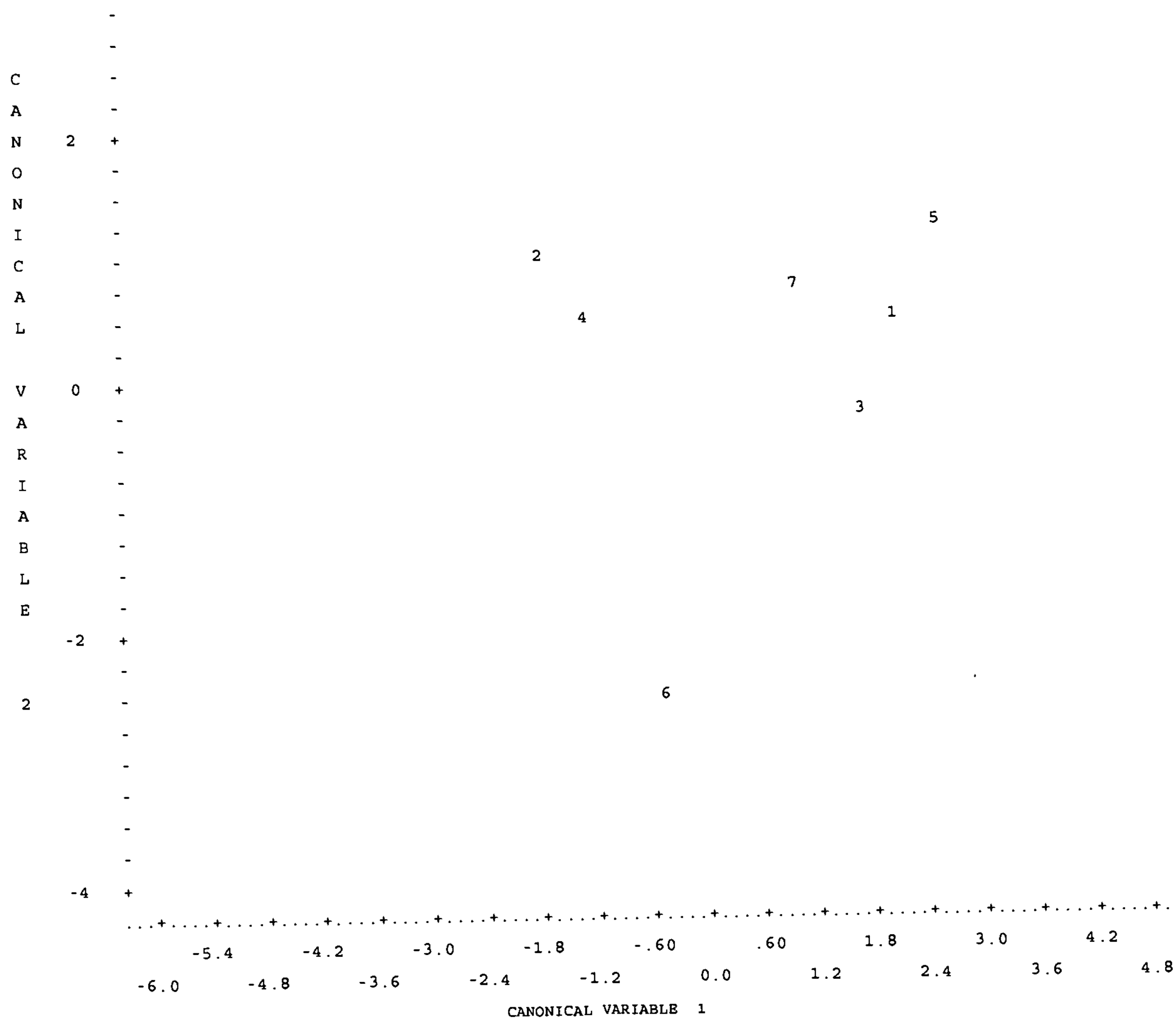
Statistic	Value
Wilk's lambda	0.0162537*
Degrees of Freedom	6, 43607
F Statistic	980.142*
Degrees of Freedom	264, 259317.50
% Cases Classified Correctly	84.0
McNemar's Repeated Measure χ^2	1881.16*
Canonical R (Best Function)	0.84696
R^2	.72
Eigenvalue (Best Function)	2.53790
% Dispersion (Best Function)	38

Discriminant Function Results for Model 3

Statistic	Value
Wilk's lambda	0.0100028*
Degrees of Freedom	6, 43607
F Statistic	883.827*
Degrees of Freedom	342, 260072.87
% Cases Classified Correctly	86.7
McNemar's Repeated Measure χ^2	108.41*
Canonical R (Best Function)	0.86064
R^2	.75
Eigenvalue (Best Function)	2.85645
% Dispersion (Best Function)	37

Figure Caption

Figure 1. Group Centroids for the 2 Best Functions of Model 3



OVERLAP OF DIFFERENT GROUPS IS INDICATED BY AN ASTERISK(*)

NOTE:
1 Physical/Biological/HealthSci/Math/Eng
2 Education/Home Economics/Ethnic Studies/ Social Sciences/Music/Psychology/English/ Communications/Foreign Lang/Philosophy/ Religion
3 Agriculture
4 Art/Architecture
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6 Business
7 Preprofessional

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