Developing a Prediction Model to Reduce a Growing Number of Psychology Majors

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This article explores problems associated with increased numbers of undergraduate psychology majors and considers strategies available to psychology departments wishing to reduce these numbers. Special attention is given to an approach using multiple regression procedures to develop a prediction model for reducing the number of psychology majors. With a prediction model, a criterion such as psychology GPA at graduation is selected, and predictors of this criterion (e.g., Introductory Psychology grade and first semester GPA) are examined. The prediction model approach is illustrated with data from Holy Cross College.

A report on the status of the undergraduate major in psychology revealed that, after several years of zero or negative growth, the number of undergraduate students selecting psychology as a major is increasing (McGovern, Furumoto, Halpern, Kimble, & McKeachie, 1991). Despite undergraduate student:faculty ratios reaching as high as 50:1 (Shepperd, 1991), many departments have not received comparable increases in faculty, staff, and operating budgets. This article investigates the problems associated with rising numbers of undergraduate psychology majors and examines several strategies for limiting these numbers. Special attention is given to an approach using multiple regression procedures to develop a weighted prediction model for reducing the number of psychology majors. An empirical illustration of a prediction model is provided using data from Holy Cross College.

Problems Arising From Too Many Psychology Majors

Some psychology departments may welcome an increase in the number majors. For example, departments that emphasize teaching over research may consider that such an increase affirms strong departmental teaching and demonstrates the overall health of the discipline. In addition, many departments may oppose restricting the number of majors on the principle that students gaining admission to college should be allowed to study whatever they wish and should not be restricted by arbitrary criteria. Although the idea of limiting the number of majors may be discomforting, an increasing number of psychology majors without comparable increases in faculty resources can result in problems for students and faculty.

For students, growth in the number of majors often means a sacrifice in the quality of education. More psychology majors frequently results in more large lecture classes and fewer classes that permit discussion or extensive writing assignments (but see Benjamin, 1991). More majors also may limit the number and quality of laboratory classes in which students traditionally gain hands-on experience designing and conducting research under faculty supervision. The result may be inadequate preparation for upper division courses and graduate school.

For psychology faculty, more psychology majors without comparable increases in faculty and educational resources often means that faculty spend more time grading and advising and less time reading, writing, and developing professionally. It also may mean teaching more and larger low-level department service courses with fewer opportunities for teaching seminars and advanced laboratory and research courses. With larger classes and fewer opportunities to teach specialty courses, teaching may become less rewarding. In addition, sabbatical leaves may be deferred or denied because a faculty member's absence would overextend an already overburdened and understaffed department. Finally, an increasing number of majors may affect promotion and tenure decisions. Faculty members who face more and more students ultimately have less time available for other academic pursuits, resulting in lower productivity in an absolute sense, as well as lower productivity relative to members of other academic departments. To the extent that promotion and tenure committees compare candidates from one department with those of another department, the demand associated with too many majors poses serious career liabilities.

Strategies for Limiting the Major

Perhaps the most attractive solution to the growing number of psychology majors entails hiring new faculty and increasing budgets; unfortunately, financial constraints preclude this option for many departments. The alternative is to reduce the number of majors. Several methods for reducing the number of majors include setting caps, a strategy used occasionally by biology and business departments, and establishing criteria for admission, a strategy used by graduate programs in psychology and other disciplines. However, having students to self-select out of psychology may seem a more desirable approach. Self-selection may be encouraged by establishing a rigorous curriculum that includes additional department courses in areas such as statistics or by requiring distribution courses in areas such as biology, math-

ematics, physics, or chemistry. Alternatively, a department could make Introductory Psychology, statistics, and experimental methodology more difficult. Both methods should dissuade students from choosing psychology as a major merely because it appears to be an easy route to attaining a degree.

Although encouraging students to self-select out of psychology has appeal, it is not without problems. First, additional requirements for majors (an "obstacle course" strategy) may be inconsistent with the department's mission. Second, making initial psychology courses more difficult unfairly burdens the faculty teaching these courses, particularly in departments demanding excellent teaching as a condition of tenure and relying heavily on teacher evaluations as an indicator of teaching excellence. The positive correlation between grades and teacher evaluations (Feldman, 1976; Howard & Maxwell, 1982; Stumpf & Freedman, 1979; Worthington & Wong, 1979) suggests that the faculty (often junior professors) teaching these courses may receive less favorable teaching evaluations.

There are alternative approaches to having students self-select out of the major. First, admission to the psychology major could be based on some form of lottery, but this approach could eliminate many students who would be excellent majors. Second, a department could require application essays. Two problems with this approach are (a) reading what may be hundreds of essays each year is time-consuming; and (b) unless strict criteria are established and followed, judging essays may be highly subjective. Third, a psychology department could require students to maintain a minimum GPA to remain in the major. Presumably, the minimum GPA would be based solely on psychology courses; overall GPA may not accurately reflect acumen in psychology. Unfortunately, a minimum GPA approach is unlikely to eliminate the problem of overcrowded courses. Students who fall short of the minimum GPA may continue to take psychology courses in an attempt to raise their cumulative psychology GPA and reenter the major. In addition, a minimum GPA requirement may unduly pressure faculty who teach courses that determine whether a student remains in the major.

This article proposes using a prediction model for limiting the number of psychology majors. With a prediction model, a criterion (e.g., psychology GPA at graduation) based on the performance of psychology majors in previous years is established. Second, multiple regression procedures are used to identify predictors that successfully explain a sizable and unique proportion of the criterion variance. These predictors are then used in a weighted prediction model to select future psychology majors. This procedure selects majors who are most likely to reach a preestablished criterion and does not depend on chance or a subjective rating system.

What follows is an empirical illustration of a prediction model using data from Holy Cross College. The illustration is followed by a discussion of how psychology departments at other institutions may develop prediction models tailored to their own students and department goals. Psychology GPA at graduation was selected as the criterion in the prediction model because it seemed to be the most objective indicator of performance in psychology courses. Nevertheless, some psychology departments may find other criteria (e.g., scores on the recently developed psychology advanced placement

test and grades in statistics or methods courses) more desirable or appropriate for their particular mission.

Method

The initial pool comprised all students ($N = 342$) receiving baccalaureate degrees in psychology from Holy Cross College from 1986 to 1990. During this time, the psychology department had an average student:faculty teaching ratio of 36:1, whereas the college reported an average ratio of 13:1. Academic transcripts and high school records provided each student's first semester GPA, first year GPA, GPA based on all psychology courses at graduation, course grade in Introductory Psychology, Verbal SAT score, and Math SAT score. Grades in the statistics and methods courses were not recorded because many students did not take these courses until their junior or senior year. High school rank was recorded for psychology majors graduating in 1986, 1987, and 1988. However, later analyses revealed that high school rank predicted a negligible proportion of unique variance. Moreover, information regarding high school rank was unavailable for almost one third of the subjects. Consequently, this variable is not discussed further.

Preliminary analyses revealed a consistent trend among a subgroup of subjects ($n = 12$) who transferred to Holy Cross during their sophomore or junior year and completed introductory psychology at other institutions. This subgroup invariably had a high grade in introductory psychology and a high first semester GPA but exhibited a dramatic decrease in GPA after enrolling at Holy Cross. For example, one student consistently achieved semester GPAs of 3.5 or higher during her 2 years at a community college. After transferring to Holy Cross, however, her semester GPA consistently fell below 2.8. Because introductory psychology and first semester GPA did not predict graduating psychology GPA for these 12 transfer students, their data were excluded from subsequent analyses. Also excluded from the initial analyses were data from 4 students for whom SAT scores were unavailable. Data from these 4 subjects, however, were included in later analyses that dropped Math and Verbal SAT scores as predictors.

Results

Table 1 presents the correlation matrix of the predictors and the criterion for all subjects and the grand means for each variable. The strongest correlate of psychology GPA at graduation was Introductory Psychology grade, followed in order by first semester GPA, Verbal SAT, and Math SAT. These later analyses thus were based on data from 330 subjects.

Predictors were identified in two stages. In the first stage, the data were analyzed using multiple regression with Introductory Psychology grade, first semester GPA, Math SAT score, and Verbal SAT score entered as predictors and psychology GPA at graduation entered as the criterion. Because the primary goal was prediction, stepwise regression procedures were used. Six separate analyses were conducted, one for each of the five graduating classes of psychology

Table 1. Correlation Matrix for all Psychology Graduates From 1986 to 1990

	Introductory Psychology Grade[a]	First Semester GPA[b]	Verbal SAT[c]	Math SAT[d]	Graduation GPA in Psychology[e]
Introductory psychology grade		.47	.31	.21	.60
First semester GPA			.29	.19	.53
Verbal SAT				.39	.32
Math SAT					.21

[a]Grand M = 3.00. [b]Grand M = 2.80. [c]Grand M = 554. [d]Grand M = 587. [e]Grand M = 3.09.

majors and one for all graduating psychology majors. In all six analyses, Introductory Psychology grade and first semester GPA emerged as the strongest predictors of psychology GPA at graduation. Indeed, these were the only predictors that consistently accounted for unique variance in psychology GPA at graduation. In no case did Math SAT predict a significant proportion of unique variance in psychology GPA at graduation. Verbal SAT score emerged as a significant predictor in the final stepwise analysis in which the data from all subjects were analyzed together, $F(3, 322)$ = 7.45, $p < .01$. However, the Verbal SAT score uniquely predicted only 1% of the total variance in psychology GPA. Because only Introductory Psychology and first semester GPA consistently emerged as significant predictors of graduation GPA, they were the only predictors retained in the next stage of analyses. Math and Verbal SAT scores were dropped as predictors.

In the second stage of the analysis, data were analyzed using simultaneous regression procedures to generate parameter estimates. In this procedure, Introductory Psychology grade and first semester GPA were entered simultaneously into a regression model. Again, six separate analyses were conducted, one for each of the five graduating classes of psychology majors and one for all graduating psychology majors combined. Table 2 presents (a) the intercept and parameter estimate for each predictor, (b) the variance absorbed by Introductory Psychology when it was entered first in the regression model, (c) the additional variance absorbed by first semester GPA when it was added to the model, and (d) the total variance explained by the two-predictor model.

Introductory Psychology grade consistently absorbed a significant and substantial proportion of the variance associated with psychology GPA at graduation, explaining anywhere from 43% to 56% of the total variance. In addition, in four of six analyses, first semester GPA also absorbed a significant proportion of the total variance, explaining up to 15% additional variance in psychology GPA at graduation.

Predicting Psychology GPA at Graduation

Using the intercept and the regression weights for Introductory Psychology and first semester GPA, the following equation predicts psychology GPA at graduation for new students not represented in the initial sample: CGPA = B_0 + B_1(Intro Grade) + B_2(GPA1), where CGPA = the criterion variable (psychology GPA at graduation); Intro Grade = the first predictor (Introductory Psychology grade); GPA1 = the second predictor (first semester GPA); and B_0, B_1, and B_2 = the structural parameters (i.e., the intercept and regression weights, respectively). For illustrative purposes, I used the structural parameters associated with the combined data of all psychology majors graduating between 1986 and 1990 (see Table 2). Imagine a student who received a B− in Introductory Psychology (2.7 garde points) and achieved a 2.93 GPA at the end of her first semester at Holy Cross College. Her predicted GPA in psychology at graduation would be: CGPA = 1.61 + (.263)(2.7) + (.248)(2.93), and CGPA = 3.05.

Imagine a second student who received a D+ in Introductory Psychology (1.3 grade points) and achieved 2.15 during

Table 2. Introductory Psychology Grade and First Semester GPA as Predictors of Psychology GPA at Graduation

Year	n	Intercept	Predictor	Beta	t	p	R^2	Total R^2
1986	47	1.58	Introductory Psychology grade	.393	5.3	.01	.46	
			First semester GPA	.127	1.4	.16	.03	.49
1987	54	1.58	Introductory Psychology grade	.406	5.3	.01	.54	
			First semester GPA	.127	1.4	.16	.02	.56
1988	61	1.41	Introductory Psychology grade	.166	2.3	.05	.30	
			First semester GPA	.403	4.0	.01	.15	.45
1989	97	1.74	Introductory Psychology grade	.234	6.3	.01	.35	
			First semester GPA	.238	4.6	.01	.12	.47
1990	71	1.43	Introductory Psychology grade	.218	2.7	.01	.35	
			First semester GPA	.343	3.1	.01	.08	.43
1986–1990	330	1.61	Introductory Psychology grade	.263	9.7	.01	.36	
			First semester GPA	.248	6.8	.01	.08	.44

Note. R^2 = The increase in explained variance associated with adding the predictor to the model.

his first semester at Holy Cross College. His predicted GPA in psychology at graduation would be: CGPA = 1.61 + (.263)(1.3) + (.248)(2.15), and CGPA = 2.49.

Setting Criteria for Majoring in Psychology

The structural parameters provide the tools for predicting psychology GPA at graduation and, hence, a means of identifying students who will and will not perform well in psychology courses. The structural parameters also provide guidelines for reducing the number of majors. For example, suppose a department wishes to reduce the number of future psychology majors by 10%. The first step would be to select a criterion and to identify variables that successfully predicted the criterion in previous years. The present illustration used psychology GPA at graduation as the criterion and identified Introductory Psychology grade and first semester GPA as the best predictors. In the event that a department selects predictors that are unavailable until after completion of certain courses or semesters, as in the present illustration, the second step would be to delay admission to the major until completion of these prerequisites. The third step would be to generate the structural parameters for the prediction model and to compute the predicted graduation psychology GPA of all students represented in the sample of psychology graduates from previous years. The fourth step would be to set a cutoff point for predicted GPA at graduation. A department that wishes to reduce the number of future psychology majors by 10% would set the cutoff at the point below which 10% of all predicted psychology GPAs would fall. The fifth step would be to accept as psychology majors only those applicants who are predicted to graduate with a GPA in psychology above the cutoff point based on the parameter estimates derived from psychology majors from previous years.

The 10% cutoff point is 2.76 in the present sample of 330 graduates. That is, 33 of the 330 graduates had a predicted graduation GPA in psychology below 2.76. Accordingly, we would accept as psychology majors only those applicants who are predicted to graduate with a psychology GPA of 2.76 or higher.

Evaluating the Prediction Model

The success of a prediction model is reflected in the accuracy with which it classifies cases. To examine the accuracy of the present model, four groups were created based on graduation GPA in psychology: (a) false negatives—students incorrectly predicted to graduate with a psychology GPA below 2.76, (b) false positives—students incorrectly predicted to graduate with a psychology GPA of 2.76 or higher, (c) true negatives—students correctly predicted to graduate with a psychology GPA below 2.76, and (d) true positives—students correctly predicted to graduate with a psychology GPA of 2.76 or higher. Examination of the data revealed 13 false negatives, 45 false positives, 20 true negatives, and 252 true positives. Stated otherwise, a discriminant functions analysis of the model correctly classified 82.4% of the cases, $\chi^2(1, N = 330) = 10.80$, $p < .0001$.

Merely examining the proportion of errors in classification belies the accuracy of the model. Among the top 50% of the 330 students graduating with a degree in psychology between 1986 and 1990, there was only 1 false negative. This 1 case was a student who received a D+ in Introductory Psychology and a first semester GPA of 2.25, yet achieved a psychology GPA of 3.32 by graduation. The remaining false negatives occurred among students graduating in the bottom 50% of all psychology majors.

Discussion

This article examines strategies for controlling an increasing number of psychology majors and uses data from Holy Cross College to illustrate the use of a prediction model to address this problem. In the illustration, the best predictors of the criterion (psychology GPA at graduation) were Introductory Psychology grade and first semester GPA. A demonstration of how these two predictors could be used in a weighted prediction model to select psychology majors in future years was provided. Psychology departments facing the problem of too many majors should not adopt these predictors blindly. Instead, a department should develop its own prediction model based on data from its own psychology graduates and tailored to its specific needs.

Several additional points should be considered if a department uses this approach to limit the number of psychology majors. First, it may be unwise to use a student's introductory psychology grade as the only predictor; it would place too much pressure on the introductory psychology professor who singly can determine whether a student is or is not admitted as a major.

Second, some good students perform poorly during their first semester in college. As a solution, a department could establish an appeal process or allow students who are denied admission to reapply and use cumulative GPA rather than first semester GPA as the predictor. Such an approach provides students who get off to a poor start academically a better chance of being admitted to the major. It also allows students to reapply after completing more courses.

Third, a department may decide to use multiple regression procedures as a guideline for establishing cutoff points for becoming a psychology major (e.g., a GPA of 2.5 or introductory psychology grade of C+ or better). Although this alternative procedure may be slightly less accurate than a weighted prediction model, it has the advantage of being easier for faculty and students to determine at a glance whether an applicant meets the criterion for admission to the major. In our sample, the combined criteria of a first semester GPA of at least 2.75 or an Introductory Psychology grade of at least C+ yielded results that were virtually identical to the results from the weighted prediction model.

Fourth, departments may not want to apply a weighted prediction model indiscriminately. Instead, departments may wish to establish an affirmative action plan in accepting applicants to ensure that minorities are included in the major.

Fifth, a department may need to provide for transfer students wishing to major in psychology by considering only those grades received since transferring. It also may be nec-

essary to require completion of introductory psychology in the destination psychology department before the student is admitted to the major.

Finally, departments may need to include a statement with admissions material sent to first-year and transfer students announcing limits on the number of students accepted as psychology majors and the procedures students should follow to become a major.

Comments on Empirical Approaches

In the present illustration, the cutoff point necessary for reducing the number of majors by 10% was a predicted graduation psychology GPA of 2.76, which may seem uncomfortably high. After all, many students predicted to fall below the cutoff may never be in danger of flunking out of school. Indeed, it may seem difficult to justify to students and parents why someone with a predicted graduation psychology GPA as high as 2.75 cannot be a psychology major. Several points should be considered before dismissing this approach as blind empiricism.

First, risk of flunking out of school was not the criterion used in developing this model. If it were, this procedure would be inappropriate for reducing the number of majors because the data used to generate this prediction model included only those students who earned a baccalaureate degree in psychology. Second, only 10% of the students in the illustration were predicted to have a graduation psychology GPA below 2.76; denying admission to these students eliminates the bottom 10% of prospective psychology majors. Third, an inspection of the transcripts of students in this sample of five graduating classes of psychology majors revealed a truncated range of grades; few students completed the degree with a psychology GPA lower than 2.76. Likewise, few received a C or C− in a psychology course, and virtually no student received a D or F. The truncated range contributes to the high cutoff point. Indeed, only 1 student in the sample of 330 was predicted to have a graduation psychology GPA below 2.40.

The high cutoff point in the present illustration is likely an extreme case. Nevertheless, departments may find it useful to convert students' predicted graduation psychology GPAs to percentiles (or perhaps stanines or z scores) before describing the criterion to students or parents. Such a conversion may make it clearer that the department is closing admission to students who are predicted to achieve a graduation psychology GPA in the bottom 10th percentile.

Conclusion

This article addresses problems associated with having too many psychology majors and considers strategies for reducing the number of majors. Although an ideal solution is to have students decide for themselves whether they should major in psychology, the burgeoning number of majors reported by many psychology departments suggests that students prefer to select into rather than out of the major. Accordingly, a weighted prediction model in which admission to the major is based on whether an applicant is predicted to meet a predefined criterion is a reasonable solution.

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Notes