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HOW DO ACADEMIC DEPARTMENTS IMPACT STUDENT SATISFACTION? Understanding the Contextual Effects of Departments

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Using multilevel modeling to analyze survey data from more than 1,300 alumni from a large research university, this study examines the impact that academic departments have on student satisfaction and development. Controlling for individual characteristics, we found that characteristics of departments such as faculty contact with students, research emphasis, and proportion of female undergraduates had a significant impact on satisfaction with education in the major and the perceived impact that college had on skill development.

KEY WORDS: student satisfaction; academic departments; multi-level modeling.

For decades, scholars and academic administrators have examined the impact that college has on students and student satisfaction. Seminal works by Feldman and Newcomb (1969) and Pascarella and Terenzini (1991) explore the relationship between students' college experiences and learning, development, and satisfaction. Scholars have long understood the impact of subunits within colleges and universities on students and have concluded that they often produce quite different influences on student development (Baird, 1988; Chickering, 1969). More specifically, several authors have noted the impact that departmental culture and climate have on student learning and satisfaction (Cameron and Ettington, 1988; Hartnett and Centra, 1977).

What do we know about the impact that different departments have on student outcomes? In fact, we know very little and what we know appears somewhat contradictory. In their review of the literature, Feldman and Newcomb (1969)

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suggest that the "differential experiences in the several major fields do have impacts beyond those attributable to initial selection into those fields" (p. 193). Research by Pascarella and Terenzini (1991) concludes that one's major has very little impact on college outcomes. The possible result of the work by Pascarella and Terenzini may be reflected in the relatively scant attention paid to the effects of discipline on student outcomes (Smart, Feldman, and Ethington, 2000). In fact, most major theoretical models explaining the effects of college development on students overlook the impact of academic departments (Bean, 1985; Pascarella, 1985; Tinto, 1993).

However, we do know that academic disciplines vary in their views of application of practical problems, cognitive processes, concern with life systems, beliefs about collaboration, faculty time commitments, and scholarly output (Becher, 1987; Biglan, 1973a, 1973b). Others suggest marked differences between disciplinary goals (Smart and Elton, 1975) and differences in course planning and delivery (Stark, Lowther, Bentley, and Martens, 1990). A recent body of literature takes some of these differences into account by applying Holland's career theory (Holland, 1966, 1985) to explain the impact of discipline on faculty and students (Smart, 1982, 1987, 1997; Smart et al., 2000). Still, while we know a great deal about the differences between disciplines, little research has been done to study the impact that different disciplines have on student outcomes. More specifically, on college campuses, disciplines are organized within departments. We know even less about the way in which departments impact student outcomes.

For researchers, studying the effects of departments poses a dilemma known as the unit of analysis problem. Although student outcomes vary across individuals in relation to individual attributes, they also vary across departments in relation to departmental attributes. Researchers have generally addressed this in three ways: they built statistical models that examined data at the group level or organizational level and neglected differences in individuals; they examined data at the individual level and ignored the impact of group membership; or they built models that attached group-level characteristics to individuals. All three approaches neglect the nested nature of the data and can result in inaccurate parameter estimates and the incorrect number of degrees of freedom. Therefore, the results may lead to poor or even misleading policy analyses. Only recently have higher education researchers begun to recognize the need to analyze data by taking into account the nested structures of institutions of higher education (Ethington, 1997; Patrick, 2001; Porter and Umbach, 2001). Multilevel modeling techniques allow researchers to appropriately handle the complex organizational effects of colleges and universities and provide the tools necessary to arrive at more accurate results.

Using multilevel modeling to analyze survey data from more than 1,300 alumni from a large, public research university, this study examines the impact

that departments have on student outcomes. Given that purpose, this study asks two major questions:

1. What impact do individual characteristics such as race, gender, age, grade point average, and transfer status have on student satisfaction and students' perceptions of the impact of their college experience on skill development?
2. What effect do academic departments have on student satisfaction and students' perceptions of the impact of their college experience on skill development?
   a. More specifically, to what extent do Holland's categories of disciplines, as applied by education researchers (Smart, 1987, 1997; Smart et al., 2000), relate to student satisfaction and perceptions of the impact of college experiences?
   b. In addition, to what extent do departmental characteristics such as size, research focus, diversity, and faculty contact with students relate to satisfaction and perceptions of the impact of college experiences?

REVIEW OF THE LITERATURE

Previous research suggests that alumni satisfaction is an excellent tool for assessing the effects of college on students (Pace, 1979; Pike, 1994). In an era where outcomes assessment is growing in importance, alumni surveys also play an important role in evaluating academic programs (Pike, 1994). But, while alumni satisfaction is important, little attention has been given to it since the 1970s and 1980s (Bean and Bradley, 1986).

In addition to student satisfaction, intellectual and personal developments are important outcomes of college. Extensive research has been done on the various dimensions of college outcomes (Bowen, 1977; Feldman and Newcomb, 1969; Pascarella and Terenzini, 1991). In their review of the literature on student outcomes, for example, Pascarella and Terenzini found at least 10 dimensions of college outcomes. This study is informed in particular by research done by Pascarella and Terenzini (1978), where they identify two particular dimensions of college outcomes—intellectual development and personal development.

A review of the literature reveals that both individual and environmental characteristics impact student satisfaction and development. In addition to individual effects, our article explores the impact of college subenvironments, academic departments and disciplines, on student outcomes.

Disciplinary Effects

Research on the impact of college on students suggests that subenvironments within the same institution can have very different influences on students (Baird, 1988; Biglan, 1973b; Chickering, 1969; Weidman, 1989). Ewell (1989) argues

that overall institutional culture is not significantly associated with student outcomes but that major departments are important in the study of the impact of college on students.

One line of research on academic disciplines, Holland's (1966, 1985) theory of careers, has been applied with some frequency to understand differences between academic disciplines in higher education. The basic premise of Holland's theory is that human behavior is a result of the interaction between individuals and their environments. Applying Holland's theory, Smart et al. (2000, p. 33) suggest that students "choose academic environments compatible with their personality types" and in turn "academic environments reward different patterns of student abilities and interests." Based on preferred activities, interests, and competencies, Holland has developed six model environments that can be translated into a typology for academic disciplines—realistic, investigative, artistic, social, enterprising, and conventional (Smart et al., 2000). We offer a brief description of his typology here.

Realistic environments focus on concrete, practical activities that often use machines and tools. Outputs are often practical, concrete, and tangible. Disciplines commonly associated with realistic environments are electrical engineering, mechanical engineering, and military science.

Investigative environments emphasize activities that focus on the creation and use of knowledge. The goal is the acquisition of knowledge through investigation and problem solving. Some of the disciplines that are considered investigative are biology, mathematics, sociology, economics, and civil engineering.

Social environments focus on the healing or teaching of others. They emphasize the acquisition of interpersonal competencies. Disciplines that are commonly associated with social environments are political science, nursing, special education, philosophy, and history.

Enterprising environments are oriented toward personal or organizational goal attainment through leadership or manipulation. They emphasize leadership development and reward popularity, self-confidence, and aggressiveness. Enterprising disciplines include business, journalism, communications, and computer science.

Artistic environments are concerned with creative activities and emphasize ambiguous, unstructured endeavors. These environments encourage the acquisition of innovative and creative competencies. Arts, English, architecture, speech, music, and theater are examples of artistic disciplines.

Finally, conventional environments focus on meeting requirements or needs through the use of numbers or machines. They emphasize a conventional outlook and are concerned with orderliness and routines. Accounting and data processing are examples of conventional disciplines.

In addition to the research that applies Holland's typology to academic disciplines, the literature points to departmental characteristics such as student-faculty relationships, structural diversity, and research emphasis of the faculty as

factors influencing student outcomes. Faculty continue to be one of the greatest influences on students' experiences in college, and a debate continues over the impact of the opposing roles of faculty work. Many have suggested that research and teaching are in conflict (Clark, 1987; Kerr, 1963). Other researchers argue that research and teaching are complementary endeavors and that faculty who do research are more likely to produce satisfied, well-educated students (Teague, 1981; Volkwein and Carbone, 1994). Still others (Feldman and Newcomb, 1969) suggest that there is no relationship between teaching and research.

Peer influences also appear to be related to student outcomes. Milem (1998) concluded that peers significantly shape students attitudes and beliefs. What characteristics of peers within a department might shape students satisfaction? Perhaps departments with students with high academic ability shape student attitudes differently than those with students with low academic ability.

Taking peer influences a step further, many researchers have investigated structural components of colleges and universities that may impact students, particularly students of color and women (Gurin, 1999; Hurtado, Milem, Clayton-Pedersen, and Allen, 1999; Milem, in press; Milem and Hakuta, 2000). Chang (1996, 1999) found that students' overall satisfaction with college is enhanced in diverse learning environments. In other words, students' learning environments with a high proportion of students of color experience greater satisfaction than those who come from homogeneous learning environments. This is true for both white students and students of color. Although we are beginning to recognize the impact that diversity of colleges and universities has on student satisfaction, little empirical work has been done to support these ideas.

In sum, besides typologies of disciplines such as Holland's, very little work has been done on the effect of disciplines. Holland's typology provides a theoretical lens through which to examine disciplinary differences, but the present study takes the typology a step further. We know that faculty within a department should have an impact, but not much research has been done on the impact of faculty within departmental units. How does a student's ability to interact with faculty impact satisfaction? Does a department that focuses on research have a different impact on student satisfaction than one that does not focus on research? Additionally, we know that peer groups impact students' college experiences, but only a few studies support this idea. How does the racial and gender makeup of one's peers within a department impact satisfaction?

Individual Effects

In addition to departmental effects, individual characteristics appear to have some relationship with student outcomes. While a great deal of literature focuses on using individual factors to predict student outcomes, very little work has been done on predicting student satisfaction. The literature suggests a com-

plex relationship between grades and satisfaction with college. Some have suggested that grades have a moderate relationship with satisfaction (Liu and Jung, 1980; Pike, 1991). Bean and Bradley (1986) found that grades had almost no relationship with student satisfaction. However, others have found that student performance (as measured by grade point average) is significantly related to satisfaction (Centra and Rock, 1983; Lavin, 1965). Likewise, given the models of student retention where satisfaction and academic performance are predictors of attrition (Tinto, 1993), one could conclude that college grades and satisfaction are closely related.

Several researchers have found significant gender differences in satisfaction with college (Adelman, 1991; Rienzi, Allen, Sarmiento, and McMillin, 1993). In most cases, women report lower satisfaction with college than do men. However, gender remains relatively unexplored when examining student satisfaction.

Little research has been done on using race/ethnicity as a predictor of satisfaction. One study did find significant differences between racial/ethnic groups on reported satisfaction (Helm and Sedlacek, 1998). However, given the vast literature on the differences between races and the college experience, one would expect differences in satisfaction. Similarly, very little research has been done on the differences in satisfaction between transfer and first-time students. At the institution in this study, almost none of the transfer students live on campus, so one would expect their satisfaction to be similar to commuter students. Research suggests that transfer students are more critical of their college experience than first-time students (Liu and Jung, 1980).

Unit of Analysis

Given that both individual and departmental factors impact students, how does one best predict student outcomes? Some researchers (Berger, 2000; Berger and Milem, 2000) suggest a complex relationship between universities and students that may cause methodological issues when determining units of analysis. This complexity arises from the interaction of individual student characteristics with the environments of institutions. Much of the current research focuses on how individual characteristics influence students, but several studies chose to aggregate individual-level outcomes data. Unfortunately, analyses of this type are prone to what is known as an "ecological fallacy" (King, 1999; Kreft and DeLeeuw, 1998; Robinson, 1950), in which aggregate-level results may substantially differ from individual-level results. To understand individual-level behavior, we must use individual-level data.

In addition to aggregating individual-level data, researchers often attempt to address group-level characteristics of a dependent variable by attaching group-level variables to individual-level data. As Ethington (1997) notes, this solution is flawed for several reasons. First, it violates the fundamental assumption of ordinary least squares that observations are independent of one another. Within

an educational institution, however, students are grouped within subunits and may more closely resemble other students in their subunit than students outside their subunit. Second, it assumes that individuals within a group are affected identically by institutional characteristics. Finally, the attachment of group-level variables to an individual does not fully capture the effect of group-level characteristics, which results in a misestimation of standard errors.

We have long recognized that the impact of college is an interactive process between students and their environment (Astin, 1993; Weidman, 1989); yet prior to the recent availability of multilevel modeling techniques, previous researchers have used simple crosstabulations, correlations, or regression analysis when studying college outcomes. Such techniques ignore the interactive processes that institutions and their subenvironments may have on outcomes. Clustering of the data can radically affect the substantive results of any analysis. Only by explicitly modeling this hierarchical structure of the data can we begin to truly understand how college impacts students.

SAMPLE AND DESIGN

This study used data from a survey of alumni at a large, public research institution. The survey itself contained more than 80 questions and was four pages long. The questions covered such topics as current employment status, satisfaction with various aspects of the institution, and self-assessed growth of skills and abilities.

All 4,952 bachelor's degree recipients for fiscal year 1999 were surveyed using the Dillman (1978, 2000) method of mail surveying in an effort to obtain high response rates. Dillman's method involves multiple contacts with respondents when doing large-scale mail surveys, using a prenotification contact, two survey mailings, and reminder postcards. Taking into account bad addresses, the final sample population was 4,524. Of that population, 1,532 surveys were returned, yielding a response rate of 34%.

Because only 34% of the population responded, we performed an initial analysis to uncover any possible response bias. Our analyses revealed statistically significant differences between the sample and the population in terms of race, gender, and transfer student status. To alleviate some of the response bias in our analyses, we weighted the sample so that it resembled the population in terms of race, gender, and transfer student status.

DATA ANALYSIS

Based on the literature on student outcomes, we proposed four multilevel (individual and departmental) models to predict student outcomes. We included department-level characteristics such as Holland discipline type, research emphasis, size, student contact with faculty, academic ability of students, and diver-

sity. We also included several individual attributes such as age, race, gender, transfer student status, and academic performance in our models.

Dependent Variables

Before developing our models, we performed an exploratory factor analysis on questions related to general satisfaction and perceptions of the impact that the institution had on enhancing skills. The factor analyses yielded four factor structures similar to those found by Pascarella and Terenzini (1978). All four are used as dependent variables in our models:

- Satisfaction with the major
- Personal skill development
- Intellectual skill development
- General skill development.

Items comprising the four constructs, their loadings, and reliability estimates are presented in Table 1.

For satisfaction, we developed one scale, *satisfaction with the major* (alpha = .72), which includes two Likert-scale items. These asked alumni to rank the degree to which they agreed that their major provided them with a solid background for their career and the degree to which they were satisfied with their major.

To develop the other three constructs, we used a battery of 13 items that asked alumni to respond on a 3-point scale about the degree to which they believed their college experiences enhanced their skills. The *personal skill development* scale (alpha = .76) included six items that asked the extent to which college enhanced skills such as teamwork, leading others, professional ethics, and understanding diverse cultural, political, and intellectual views. *Intellectual skill development* (alpha = .71) is a seven-item scale that asked the extent to which their college experiences enhanced skills such as writing, solving problems, thinking critically, and processing and interpreting data. The final scale, *general skill development* (alpha = .82), included 10 items from the other skill development scales, such as writing effectively, speaking effectively, clarifying values, solving problems, and thinking creatively.

Respondents were deleted from the final sample if they answered less than half of the questions related to development, if they answered none of the major satisfaction questions, or if their major was not located in a specific department (e.g., general studies). Mean substitutions were performed for the remaining missing variables prior to building the constructs. Each of the constructs was standardized to aid in interpretation and to enable comparisons across models. The remaining 1,356 individuals from 54 departments were used as the final

TABLE 1. Dependent Variable Factor Scales

Scales	Factor Loadings
Satisfaction with major*	
Major provided a solid background	0.89
Satisfied with the quality of education in major	0.89
Alpha = .73	
Enhanced general development**	
Writing effectively	0.52
Speaking effectively	0.62
Clarifying values	0.60
Solving problems	0.63
Thinking creatively	0.70
Thinking critically	0.69
Teamwork	0.61
Leading others	0.65
Professional ethics	0.64
Understanding diverse cultural, pol., intell. views	0.56
Alpha = .82	
Enhanced intellectual development**	
Writing effectively	0.47
Solving problems	0.77
Thinking creatively	0.70
Thinking critically	0.77
Computer/IT	0.47
Processing/interpreting data	0.55
Science and experimentation	0.51
Alpha = .71	
Enhanced personal development**	
Speaking effectively	0.65
Clarifying values	0.63
Teamwork	0.69
Leading others	0.75
Professional ethics	0.70
Understanding diverse cultural, pol., intell. views	0.61
Alpha = .76	

*1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree.
**1 = not at all, 2 = moderately, 3 = extremely.

sample. The average department size was 24 respondents, ranging from 1 to 232. See Table 2 for department frequencies.

Independent Variables

At the individual level (or in multilevel modeling terms, level-1), we included several variables from institutional databases including the alumnus' race/

TABLE 2. Departmental Frequencies

Holland Typology	Department	*N*	% of Sample
Artistic	Architecture	9	0.7
	Art	21	1.5
	Art History & Archeology	12	0.9
	Asian & East European Lang. & Lit.	8	0.6
	Classics	1	0.1
	Dance	5	0.4
	English	66	4.9
	French & Italian Lang. & Lit.	4	0.3
	Germanic Studies	3	0.2
	Linguistics	2	0.1
	Music	5	0.4
	Spanish & Portuguese Lang. & Lit.	14	1.0
	Theatre	7	0.5
Enterprising	Business & Management	232	17.1
	Communication	29	2.1
	Computer Science	45	3.3
	Journalism	35	2.6
Investigative	Animal & Avian Sciences	14	1.0
	Astronomy	1	0.1
	Biological Resources Engineering	12	0.9
	Biological Sciences	116	8.6
	Chemistry & Biochemistry	12	0.9
	Economics	23	1.7
	Engineering–Aerospace	10	0.7
	Engineering–Chemical	16	1.2
	Engineering–Civil	22	1.6
	Geography	12	0.9
	Mathematics	6	0.4
	Microbiology	9	0.7
	Natural Resource Sciences	10	0.7
	Physics	2	0.1
	Sociology	32	2.4
Realist	Engineering–Electrical	40	2.9
	Engineering–Mechanical	23	1.7
Social	Afro-American Studies	4	0.3
	American Studies	5	0.4
	Anthropology	6	0.4
	Criminology & Criminal Justice	90	6.6
	Education–Curriculum & Instruction	72	5.3
	Education–Human Development	18	1.3
	Family Studies	35	2.6

TABLE 2. (*Continued*)

Holland Typology	Department	*N*	% of Sample
	Government & Politics	72	5.3
	Health Education	23	1.7
	Hearing & Speech Sciences	14	1.0
	History	24	1.8
	Jewish Studies	1	0.1
	Kinesiology	45	3.3
	Philosophy	2	0.1
	Psychology	53	3.9
	Special Education	7	0.5
	Women's Studies	4	0.3
Other	Agricultural & Resource Economics	1	0.1
	Engineering–Fire	11	0.8
	Food Sciences	11	0.8
	Total	1,356	100.0
	N of departments	54	
	Average department size	25	

ethnicity, gender, age, cumulative grade point average (GPA), and transfer status. Means and standard deviations for all variables are presented in Table 3. Race/ethnicity was included in the model using three dummy variables for African American, Asian Pacific American, and other students of color, with White as the reference category. We included gender and transfer status in the model as a dummy-coded variables as well. Cumulative GPA at graduation and age at the time of the survey were two continuous variables also included in the model at level-1. Together these variables measure individual attributes of each alumnus that should affect their satisfaction and perceived gains in skills and abilities.

We also included a second set of variables to ascertain the impact of departmental organization on student outcomes. These variables are all measured at the departmental level using department data collected in Fall 1997, approximately the junior or senior year of the individuals in our population. Henceforth, we refer to these as group-level, or level-2, variables.

We coded each department using Smart, Feldman, and Ethington's (2000) application of the Holland typology (see Table 2 for the departments and categories). We had no students in the conventional majors, so only five Holland categories (artistic, realistic, investigative, social, and enterprising) and an

TABLE 3. Variable Means and Standard Deviations

Variables	Mean	*SD*
Dependent variables		
Satisfaction-major	7.797	1.683
General development	31.899	3.936
Intellectual development	18.707	2.676
Personal development	22.306	2.639
Individual-level independent variables		
Cumulative GPA	3.127	0.496
Transfer student	0.379	0.485
Female	0.588	0.492
Age	25.314	4.369
Minority–Black	0.114	0.318
Minority–Asian	0.134	0.341
Minority–other	0.098	0.297
Group-level independent variables		
Proportion nonwhite undergraduates	0.271	0.162
Proportion female undergraduates	0.561	0.270
Combined SAT midpoint	1,196.864	72.361
Average class size	38.295	18.880
Instructional FTE faculty	19.049	17.348
Grant dollars per instructional FTE (logged)	9.104	3.886

"other" category were included in the analysis as indicator variables. Artistic departments are the omitted category in the model.

Three variables describe the undergraduate student body in each department. The proportion of female undergraduates and proportion of undergraduates of color are two diversity measures. Because departmental SATs are reported using the 25th and 75th percentiles, the midpoint of the 25th and 75th percentiles of the SAT for students within a major is used as a proxy for academic ability of students within a department. Because of the high correlation between SAT scores and college GPAs, we have not included SAT scores at the individual level.

Three additional variables proxy the alumnus' experience with faculty within a department. Instructional FTE is used to represent department size and is defined as the number of full-time equivalent instructional tenured or tenure-track faculty. We also use average class size as a measure of student contact with faculty. This is defined as the average size of lecture courses taught by a department, not including specialized courses such as individual instruction or thesis courses. Labs and discussion sections are not included in this average. We calculate grant dollars per FTE by dividing the total expenditures for re-

search contracts and grants and dividing by the instructional faculty FTE. Because of the non-normal distribution of grant dollars, we log grant dollars per FTE to ensure normality (Tufte, 1974).

With such closely related variables in our level-2 model, multicollinearity could be a major concern. An examination of the correlations shown in Table 4 reveals low correlations between the variables. These relatively low correlations confirm our assumption that the six group-level variables included in our models measure different constructs.

Modeling Strategy

The first step in multilevel modeling is the calculation of the amount of variance in the dependent variable explained by group (department) membership, or the interclass correlation (ICC). The ICC is calculated by building a fully unconditional model (often referred to as a one-way ANOVA model) where no predictors are specified. The ICCs for the four dependent variables ranged from .06 (satisfaction with major and general development) to .08 (personal development. In other words, 6 to 8% of the variance in each of our dependent measures is explained by group membership. While these ICCs are somewhat modest, they are large enough to suggest that group membership has an impact on our outcomes and that multilevel modeling is the appropriate statistical approach.

After calculating the ICCs, we added independent variables to the model. When adding independent variables, we must consider how to center the variable and whether to enter it as random or fixed. Variables can have a fixed effect or a random effect. If theory guides one to assume that the impact of the independent variable will be the same for individuals in every group, the variable is said to have a fixed effect. If theory guides one to assume that the impact of the independent variable will be different for different groups, the variable is said to have a random effect, or is free to vary across groups. For variables that are said to have a random effect, their variance is partitioned into what is attributed to the group and what is attributed to the individual. However, because the multilevel model requires large amounts of data, the decision to include a random effect is often predicated by the number of groups in a data set and the number of observations within each group. For our models, theory would suggest that race and gender should be entered in our models as random effects, but due to the limitations in our data set these models would not converge.

As a result, we left only the intercept as random and could only model average group differences. Thus, our models assume that the impact of the individual-and group-level variables is the same across departments; however, the average level of satisfaction within a department can vary across departments. For example, students in Department A could be much less satisfied than students in Department B, but if the average class size was reduced by the same amount

TABLE 4. Correlations of Level-2 Variables

	Instructional FTE	Average Class Size	Prop. Nonwhite Undergrads	Prop. Female Undergrads	SAT Midpoint	Logged Grants per Instructional FTE
Instructional FTE	—					
Mean class size	0.270	—				
Proportion ugs nonwhite	0.171	0.258	—			
Proportion ugs female	–0.372	–0.064	–0.186	—		
SAT midpoint	0.002	–0.161	0.074	–0.137	—	
Logged grants per instructional FTE	0.228	0.383	0.232	–0.258	–0.168	—

in each department, satisfaction would increase by the same amount in each department.

Centering is generally used to facilitate interpretation of the intercepts in the model. Variables are centered when the mean value of a variable is subtracted from the value the variable takes for each observation. If the mean is calculated across all observations, then the variable is grand mean centered; if the mean is calculated across observations in each cluster, then the variable is group mean centered. A general convention used in multilevel modeling is to grand mean center all fixed level-1 variables and group mean center all random level-1 variables. At level-2, in most cases, all independent variables are grand mean centered. So, for all of our models, we have grand mean centered all level-1 and level-2 variables.

We built eight models, two models for each dependent variable. In the first model, for each dependent variable we included all of the independent variables at level-1 and only the dummy-coded Holland category variables at level-2. By only including the Holland categories at level-2, we hoped to ascertain whether the application of Holland's typology provided any insight into understanding the impact of discipline on satisfaction. In the second model, we added the other level-2 predictors (research emphasis, size, student contact with faculty, academic ability of students, and diversity) to understand the impact of department characteristics other than the academic environment as measured by Holland's typology.

RESULTS

We estimated parallel models for each of our four independent variables. The full multilevel models, variance estimates, and reliabilities can be seen in Table 5. Given the relatively small within-group sample size, it is important to examine the reliabilities of each of the models. The reliabilities of our models ranged from .31 to .45, all within an acceptable range (Kreft and DeLeeuw, 1998), suggesting that the intercept can be modeled as a random rather than fixed effect.

Satisfaction with Education in the Major

Two models were created to predict student satisfaction with education in the major. Model I, which includes only the Holland codes at level-2 and all of the level-1 predictors, indicates that no significant differences exist between the Holland groups in their relationship to satisfaction with the major. This suggests that the Holland environments do little to explain group differences in satisfaction with the major.

Model II, where the remaining group-level variables are entered in the model,

TABLE 5. Model Estimates

	Satisfaction with Major		General Development		Intellectual Development		Personal Development	
	I	II	I	II	I	II	I	II
Slope coefficients (fixed)								
Department variables								
Intercept	–0.033	–0.072	–0.012	–0.059	0.026	–0.014	–0.044	–0.094*
	(0.047)	(0.049)	(0.040)	(0.037)	(0.045)	(0.048)	(–0.043)	(–0.038)
Holland–realist	0.072	–0.203	–0.187^{+}	–0.203^{+}	0.420**	0.129	–0.192	–0.172
	(0.160)	(0.149)	(0.095)	(0.119)	(0.133)	(0.177)	(0.125)	(0.160)
Holland–investigative	0.030	–0.113	–0.245*	–0.353**	0.189	0.041	–0.140	–0.237
	(0.140)	(0.129)	(0.118)	(0.118)	(0.125)	(0.140)	(0.125)	(0.145)
Holland–social	0.131	–0.016	0.008	–0.331*	0.018	–0.139	0.160	–0.212
	(0.133)	(0.162)	(0.107)	(0.133)	(0.107)	(0.164)	(0.132)	(0.160)
Holland–enterprising	0.214	0.132	–0.049	–0.149	0.098	–0.050	0.112	0.010
	(0.158)	(0.145)	(0.151)	(0.132)	(0.139)	(0.160)	(0.223)	(0.183)
Holland–other	–0.034	–0.094	–0.488**	–0.643**	0.139	0.010	–0.438*	–0.578**
	(0.206)	(0.184)	(0.167)	(0.164)	(0.192)	(0.185)	(0.189)	(0.188)
% nonwhite majors		0.313		–0.295		–0.088		–0.193
		(0.375)		(0.240)		(0.354)		(0.248)
% female majors		0.371^{+}		0.564**		–0.006		0.682**
		(0.213)		(0.195)		(0.239)		(0.214)
Combined SAT score		0.001		–0.001		0.000		–0.002^{+}
		(–0.001)		(0.001)		(0.001)		(0.001)
Average class size		–0.003		–0.004^{+}		–0.003		–0.005*
		(0.003)		(0.002)		(0.003)		(0.003)
FTE faculty		0.003		0.003		0.003		0.004
		(0.002)		(0.002)		(0.003)		(0.003)
Grant dollars (logged)		0.066**		0.047**		0.050*		0.046**
		(0.020)		(0.015)		(0.019)		(0.015)

Student variables								
Cumulative GPA	0.214**	0.213**	0.020	0.013	0.041	0.036	–0.003	–0.010
	(0.059)	(0.059)	(0.041)	(0.043)	(0.040)	(0.039)	(0.046)	(0.047)
Transfer student	0.030	0.015	–0.132*	–0.141*	–0.091	–0.103^{+}	–0.168*	–0.176**
	(0.063)	(0.065)	(0.064)	(–0.064)	(0.061)	(0.061)	(0.067)	(0.067)
Female	–0.123*	–0.126*	–0.009	–0.038	–0.167**	–0.156**	0.061	0.030
	(0.053)	(0.051)	(0.049)	(0.049)	(0.048)	(0.050)	(0.054)	(0.052)
Age	0.112	0.104	–0.008	–0.009	–0.001	–0.001	–0.012*	–0.013*
	(0.087)	(0.086)	(0.006)	(0.006)	(0.007)	(0.007)	(0.006)	(0.006)
Minority–Black	0.140^{+}	0.121	0.125	0.133	0.228**	0.223**	0.072	0.082
	(0.078)	(0.080)	(0.087)	(0.087)	(0.079)	(0.078)	(0.084)	(0.085)
Minority–Asian	–0.156*	–0.176**	–0.165*	–0.158^{+}	–0.195^{+}	–0.213*	–0.084	–0.079
	(0.066)	(0.065)	(0.081)	(0.082)	(0.109)	(0.104)	(0.075)	(0.077)
Minority–other	0.009	0.010	0.042	0.043	0.033	0.034	0.102	0.102
	(0.007)	(0.007)	(0.098)	(0.098)	(0.086)	(0.084)	(0.090)	(0.091)
Slope variances (random)								
Dept. intercepts	0.059	0.045	0.034	0.029	0.049	0.058	0.058	0.046
Chi-square	95.79**	77.07**	84.37**	65.67**	99.77**	100.36**	118.18**	84.48**
Residual	0.940	0.939	0.952	0.949	0.948	0.944	0.917	0.914
Model statistics								
Reliability of intercepts	0.44	0.39	0.34	0.31	0.41	0.44	0.45	0.40
N	1,315	1,315	1,333	1,333	1,333	1,333	1,333	1,333

**$p < .01$, *$p < .05$, $^{+}p < .10$.

reveals that two contextual factors significantly impact satisfaction with education in the major. Controlling for the other variables in the model, the proportion of female undergraduates in a department is positively related to major satisfaction. In other words, alumni in departments made up of a large proportion of women had greater satisfaction with the education in their major. Focus on research also appears to be positively related to satisfaction with the major. As grant dollars per instructional FTE increases, the satisfaction that alumni had with their major increases.

At the individual level, cumulative grade point average appears to be positively related with satisfaction with the major. Those with higher GPAs are more satisfied with their major. Gender and race also appear to have a significant relationship with satisfaction. Women and Asian Pacific Americans were on average less satisfied with their education in their major.

General Skill Development

The second set of models predicts students' perceptions of the impact of their college experience on overall skill development. Model I in this set includes the seven variables at level-1 and the Holland codes at level-2. This model suggests a significant relationship between Holland categories and the dependent variable. Individuals in realistic and investigative departments had a significantly lower rating of the impact of college on general skill development than did individuals in artistic departments.

Model II indicates a significant relationship between other department characteristics, such as student contact with faculty in the department, gender makeup of the students in the department, and research focus of the department and the average perceived impact of college on skill development. As the proportion of female undergraduates in a department increases, the average perceived impact of college increases. When contact with faculty decreased (or average class size increased), average student ratings decreased. As grant dollars per instructional FTE increases, the average perceived impact of college on general development increases.

It is interesting to note that when the additional group-level characteristics are added the Holland categories in the model, the magnitude of the coefficients increases. The impact of academic environment, as measured by the Holland typology, becomes more clear after other measures of the departmental environment are included in the model.

At the individual level, race and transfer status are statistically significant predictors of the dependent variable. On average, Asian Pacific Americans rated the impact of college on general skill development lower than Whites. Again, transfer students on average rated the impact of college significantly lower than first-time students.

Intellectual Skill Development

The models predicting alumni assessments of the degree to which their college experience enhanced their personal skill development revealed several individual and group effects. When the Holland categories are the only measures included at level-2, only the realistic departments are significantly different than artistic departments. Alumni in realistic departments reported significantly higher perceptions of the impact of college on intellectual skill development.

When the other group-level characteristics are entered in the model, only one level-2 variable was found to be a significant predictor of the average perceived impact that college had on intellectual skill development. Departmental research focus, as proxied by grant dollars per FTE, was positively related with the dependent variable. The differences in the Holland categories seen in the other model disappear. Most likely, the differences between the realistic and artistic departments are captured in the research focus of the department.

At the individual level, gender, race, and transfer status all had a significant relationship with the dependent variable. Females assessed the impact of college on intellectual development significantly lower than males. Likewise, transfer students assessed the impact significantly lower than first-time students. However, African American students rated the impact of college on intellectual development higher than White students, and Asian students rated the impact of college significantly lower than white students.

Personal Skill Development

The models predicting personal skill development appear somewhat different than those predicting intellectual skill development. As with some of the other models, the Holland categories alone at level-2 reveal no significant differences.

However, when other group characteristics are added, several significantly predicted the mean score for personal development. Similar to satisfaction and general skill development, the proportion of females had a significant positive relationship with assessment of the impact that college had on personal skill development. The higher the proportion of females within a discipline, the higher the rating of the impact of college experiences on personal skill development. As most would expect, student contact with faculty also had a significant relationship with the dependent variable. As average class size increased, the less alumni believed that college enhanced their personal skill development.

Unlike any of the other models, the academic ability of students in the department, or SAT midpoint, had a negative relationship with the perceived impact of college on the dependent variable. One explanation for this may be that the more selective a department, the more competitive the environment. This competitiveness may result in an environment that is perceived as less supportive and less concerned with personal development.

At the individual level, transfer status and age had a significant negative relationship with personal skill development. Transfer students believed that their college experience enhanced their personal skill development significantly less than first-time students; older students responded that their college experience enhanced their personal skill development significantly less than younger students.

LIMITATIONS

While this study used a powerful modeling technique, it is not without its limitations. First, we were limited to the number of variables we could use to adequately represent the culture of a department. Because of the size of the institution, a limited number of variables are collected and aggregated at the departmental level. We included the independent measures that we felt could best represent factors, as indicated in the literature, which may impact satisfaction.

Second, we were limited by the data collected on the alumni survey. Many of the survey items were either mandated by the state coordinating body or were part of a previous survey that could not be changed because of the administration's desire to have longitudinal data. Although we were guided by the literature in the building of our scales, many of them could have been better measured by questions used on surveys that had been tested more extensively. Ideally, we would have more direct measures of constructs like peer and faculty interactions and an individual's perceived fit with their major.

Third, we had limited variability on many of the questions in the survey. Most of the survey responses were quite favorable, which may suggest some response bias. Whatever the reason, we were left with measures that had little variability.

Fourth, while we attempted to overcome the impact of a low response rate by weighting our sample, we recognize the fact that we cannot account for all of the variables that might cause response bias. Given that research on student outcomes relies on surveys and that response rates have dropped nationally, research (Dey, 1997) suggests that weighting is one solution to the dilemma.

Another possible limitation of this study that we could not explore is the person-environment fit. Research (Feldman et al., 1999; Holland, 1966, 1985; Smart et al., 2000) indicates that the person-environment fit is an important component of change and development. Some of the students may have reported low satisfaction or attributed small developmental gains to their college experience as a result of a bad fit with their department. Additionally, because of individual student personalities, some students may also self-select into majors that are competitive or place a high priority on research. We cannot attend to these phenomenons in our analyses.

Finally, multilevel modeling generally requires a very large sample size, which we did not have. Because tests of significance are run at the group level, multilevel modeling requires a large number of groups with many individuals within each group. Ideally, we would have a data set with more than 50 groups and at least 10 individuals per group. For this study, just over 50 groups were analyzed with several of the groups having less than 10 members. As a result, we were only able to model the random intercept and no other random slopes even though theory would suggest that we should do otherwise.

Given our sample, we also offer a word of caution about the generalizability of the study. The data used in the analysis were collected at only one institution, and any conclusions drawn from the results should be treated as such.

DISCUSSION

Several important observations can be made about the analyses. First, the analyses provide a great deal of information about individual predictors of satisfaction. The relationship between GPA and our dependent measures appears to reflect the contradiction in the literature. GPA is a significant predictor of satisfaction with education in the major. Yet, there appears to be no relationship between GPA and the perceived impact of college on skill development. Furthering the complexity of the relationship between GPA and satisfaction is that some of the literature suggests that the two may have a recursive relationship (Bean and Bradley, 1986; Pike, 1991).

Student race and gender also appear to be salient predictors of the college outcomes measured in this study. As with previous studies (Adelman, 1991; Rienzi et al., 1993), females consistently rated satisfaction and the college impact on development lower than males. The findings of the impact of race on the outcomes parallel previous research as well (Helm and Sedlacek, 1998). African Americans in the sample reported higher ratings of the impact of college than did Whites. Asians consistently reported lower satisfaction with the education in their major and the impact of college on general skill development.

These data also suggest that transfer students have a different experience than first-time students. On all of the skill development scales, transfers rated the impact of college lower than first-time students. Few, if any, transfer students live on campus at any time during their academic career on campus. As a result, many do not become fully integrated into the campus and do not experience many of the cocurricular activities that have proven to impact students. In addition, transfer students spend fewer semesters at the institution compared with first-time students.

Most interesting are the relationships between department characteristics and satisfaction and impact of college ratings. This provides mixed results in the explanatory power of the Holland typology. No significant differences were

found between Holland types when predicting average personal skill development and satisfaction. Some differences were seen between types when modeling general skill development and intellectual skill development. However, when predicting intellectual development, when other department characteristics were added to the model, only realistic departments and artistic departments were significantly different. We are not suggesting that the Holland typology is not important when studying student outcomes; we do argue, however, that other departmental characteristics may provide a better understanding of the differences between departments.

In addition to furthering our understanding of differences in student outcomes between disciplines, this study provides some evidence of interesting relationships between department characteristics and student outcomes. A department's racial diversity appears to have little relationship with the outcomes in this study. This may be a true nonfinding, but it may instead be attributed to the non-normality of the proportion of undergraduates measure. We cannot say conclusively that diversity does not matter; however, we cannot provide evidence that it does.

Gender diversity of departments does appear to make a difference in impacting the outcomes we studied. The impact of the proportion of female undergraduates appears important, particularly in terms of satisfaction with the major and personal skill development. The data suggest that departments largely made up of female undergraduates have a positive impact on the college experience—even after controlling for department size, research emphasis, and the academic focus of the department (artistic, realistic, etc.).

The research presented here provides further support that the role of faculty appears to be extremely important in predicting student outcomes. In departments where faculty focus on research (as proxied by research dollars per FTE faculty), students appear more satisfied with their major and report a higher impact of college experiences on skill development. This suggests that departments where faculty are likely to get more research money, such as the sciences and engineering, have students that are more satisfied. It also might suggest that a prestige halo comes with earning large research grants. Often, departments that earn more grants are considered more prestigious, perhaps resulting in a preconceived notion of satisfaction.

The impact of research emphasis does somewhat contradict the notion of the "academic ratchet" (Massy and Zemsky, 1994). The impact of class size provides support for the negative impact of the ratchet, but the impact of research emphasis seems to have an opposite effect than what the ratchet would suggest. Perhaps institutions that can balance the ratcheting up of faculty research with small class sizes will have a greater positive impact on student outcomes.

The findings from our multilevel analysis of alumni survey data inform policy and practice in two areas. First, we argue that individual attributes matter. Stu-

dents of different races/ethnicities and genders experience higher education differently and, therefore, have different levels of satisfaction. One of the most apparent differences in satisfaction and perceptions of skill development is between transfer and first-time students. To increase overall satisfaction of alumni, institutions need to look at the experiences of groups such as transfer students.

Second, this study provides evidence of the impact of organizational attributes on student outcomes. As the focus on student satisfaction and the first-year experience continues to grow, we need to go beyond comparing differences between institutions and begin to look at differences within institutions. In particular, we need to examine how departments are structured. Student contact with faculty, gender diversity of departments, and departmental research emphasis all appear to have a significant relationship with satisfaction.

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