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Engaging Undergraduates in Science Research: Not Just about Faculty Willingness

Kevin Eagan, Jessica Sharkness, Sylvia Hurtado, Mitchell Chang, Cindy Mosqueda

University of California, Los Angeles

Contact: M. Kevin Eagan Jr., 405 Hilgard Ave., 3005 Moore Hall, University of California,  
Los Angeles, CA 90095-1521; Phone: (310) 825-1925.

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**Abstract**

Participation in undergraduate research opportunities provides students with important co-curricular experiences that help them to clarify career goals and apply classroom knowledge to real-world problems. On campuses where structured undergraduate research programs do not exist, faculty must themselves create these opportunities for students, yet few investigations have considered the factors that affect faculty's decision to involve undergraduates in research. Using hierarchical generalized linear modeling to analyze data from a national survey of faculty, this multi-campus study examines the individual experiences and institutional contexts that predict faculty's engagement of undergraduates in research.

## Introduction

As a group, students who initially enter college with the intention of majoring in science, technology, engineering, or mathematics (STEM) have substantially lower completion rates in these disciplines than do their peers who enter with aspirations for a non-STEM major. Compounding this problem, under-represented racial minority (URM) students in STEM have substantially lower bachelor's degree completion rates when compared with their White and Asian American counterparts. A recent report by the Higher Education Research Institute ([HERI], 2010) indicated that just 24.5% of White students and 32.4% of Asian American students who entered college with the intention of majoring in a STEM field completed a bachelor's degree in STEM within four years while 15.9% of Latino, 13.2% of Black, and 14.0% of Native American students who intended to pursue a STEM major at college entry completed a STEM degree within four years.

Given the low retention and degree completion rates of students who initially choose to major in STEM, policymakers have called for STEM faculty to become more engaging and innovative both inside and outside of the classroom (Committee on Science, Engineering, and Public Policy, 2007). To incentivize this innovation, federal agencies have provided funding to support the development and implementation of co-curricular programs designed to improve completion rates in STEM and encourage students to pursue doctorates in these fields. One such type of program is the undergraduate research experience, which provides students with hands-on training in which they apply classroom knowledge to real-world problems (Seymour, Hunter, Laursen, & Deantoni, 2004). Scholars have noted many benefits of research participation for undergraduates, including improved ability to work and think like a scientist, clarification of

career plans, improved preparedness or desire for graduate study, and higher STEM retention rates (Espinosa, 2009; Hunter, Laursen, & Seymour, 2006; Seymour et al., 2004).

Because many research opportunities are dependent upon funding, not all students have the opportunity to participate in structured research programs. On campuses where such research programs do not exist or where large proportions of students do not participate in such programs, faculty must themselves offer research training to students if they want students to have hands-on research experience. Working with a faculty member on a research project, whether within or outside of a formal research program, not only provides the hands-on training identified by Seymour et al. (2004) but also allows students to establish closer ties with faculty members, and previous research has shown that having meaningful interactions with faculty often increases STEM students' chances of persisting to degree completion in their chosen field (Cole & Espinoza, 2007).

Unfortunately, few studies have explored the factors that influence faculty members' decisions to include undergraduates in their research. In one of the only studies examining predictors of engaging undergraduates in research, Einarson and Clarkberg (2004) found that, on one campus, teaching undergraduate courses, having outside funding, and being a junior faculty member positively predicted professors' inclusion of undergraduates in research. In contrast, faculty who primarily worked with graduate students or found it difficult to interact with undergraduates tended to be less likely to conduct research with undergraduates. Individual incentives and barriers aside, faculty also face institutional and departmental obstacles in involving undergraduate students in research, as promotion and tenure systems typically emphasize research productivity over engagement with and mentoring of undergraduate students (O'Meara & Braskamp, 2005). No study has undertaken a comprehensive multi-campus analysis

of faculty data to predict faculty members' decisions to involve undergraduates in their research. This study utilizes data from a national survey of faculty to understand the individual and institutional predictors of professors' likelihood to engage undergraduates in research.

## Literature Review

### *Issues of Faculty Workload*

Faculty face significant barriers to including undergraduate students in their research projects. These barriers include a heavy workload, a reward structure that does not incentivize mentoring students, limited funding, and the potentially daunting amount of time required to mentor and train undergraduate researchers. Scholars consistently have found that faculty time is notoriously scarce, as professors at all ranks regularly work over fifty hours per week and admit that core responsibilities, such as teaching and service, make it difficult to focus on research (Jacobs & Winslow, 2004; Link, Swann, & Bozeman, 2008; Sharobeam & Howard, 2002). Even with difficulty in finding the time to devote to research, faculty continue to produce scholarship, as O'Meara and Braskamp (2005) found that, although chief academic officers had increased their expectations of faculty members' engagement with students between 1991 and 2001, these expectations had increased at a slower rate than research productivity benchmarks.

Given that faculty workload eventually becomes a zero-sum game, where more time on teaching results in fewer hours being devoted to research and vice versa, an examination the factors that predict faculty members' likelihood to engage undergraduates in research needs to consider the ways in which faculty allocate their time. Faculty workload has risen across all institutions during the last 25 years (Milem, Berger, & Dey, 2000; Schuster & Finkelstein, 2006; Townsend & Rosser, 2007), but the activities that faculty spend their time on continue to vary by institutional type. Townsend and Rosser (2007) found that faculty members at research

universities averaged the greatest number of hours engaged in research, had the most articles in refereed journals, and presented most frequently at conferences; however, these faculty also ranked lowest in classes taught and total credit hours in classes per week. The variation in faculty time allocation likely has a connection to the incentive structures in place at institutions, as colleges and universities tend to offer the greatest rewards to professors who spend the most time engaged in research and are most productive in publishing (Aguirre, 2000; Blackburn & Lawrence, 1995; Rice, 1986). Regardless of Carnegie classification, research-oriented faculty are typically paid more than their teaching-oriented colleagues (Bland et al., 2005; Fairweather, 1993, 1997, 2005; Porter & Umbach, 2001; Townsend & Rosser, 2007). In addition to increased pay, faculty members, particularly at research universities, derive greater tangible and intangible rewards, such as tenure and status within their institution and discipline, from having a more productive research agenda (Park, 1996; Schuster & Finkelstein, 2006).

Not only does the way in which faculty allocate their time vary across institutions but it also differs by gender, race/ethnicity, rank, tenure status, discipline and marital status (Antonio, 2002; Bellas & Toutkoushian, 1999; Park, 1996; Turner, 2002). Bellas and Toutkoushian (1999) found that male professors devoted more time to research than their female counterparts. However, this time allocation also differed across academic rank, as female full professors spent the fewest hours per week teaching but the most amount of time in service roles. Olsen, Maple and Stage (1995) did not find evidence to support the hypothesis that women and underrepresented minority professors at a research institution had a significant bias toward teaching and serving. Instead, Antonio's (2002) study showed that ethnic minority faculty placed greater importance on research and tended to spend more time conducting research each week compared to their White colleagues.

The hours per week that faculty spend on various activities tends to change as faculty advance in academic rank (Bellas & Toutkoushian, 1999). Non-tenured faculty spend more time teaching each week whereas full professors spend significantly more time on research than assistant professors. Disciplinary differences show that research university faculty in engineering, health sciences, and natural science spend less of their time teaching and more in research than their colleagues in humanities, fine arts, and social sciences (Fairweather & Beach, 2002).

Because of the many demands placed upon faculty, faculty-student collaboration may be challenging and not as beneficial for faculty as it is for undergraduate students (Harvey & Thompson, 2009). Implementing and maintaining a research program is time-intensive and requires institutional support, faculty commitment, and support staff to ensure success. In a study of a program at the University of California, San Diego, Davis, Poste, and Kelly (2005) underscored the need for “dedicated, enthusiastic personnel” necessary to run the program successfully. For instance, the director of a research program must not only be interested in undergraduate education and the discipline but also must have institutional or departmental support in the form of protected time (e.g., course buyout).

Working with undergraduate students on research projects can be especially difficult if faculty lack appropriate support (Merkel, 2001; Prince, Felder, & Brent, 2007). Faculty have cited concerns that integrating undergraduates on research projects may hinder their productivity, as they may end up spending more time training and orienting undergraduates to the lab or research project and less time conducting research (Prince, Felder, & Brent, 2007). Harvey and Thompson (2009) underscore this point, as they note that “a significant barrier to research productivity at [predominantly undergraduate institutions] is availability of time; and faculty

efficiency and time balancing therefore become a major consideration when engaging students in research” (p. 13).

### *Faculty Mentorship*

Although it can be time-intensive on the part of faculty, the benefits of mentorship for students are well documented for students generally (Crisp & Cruz, 2009; Jacobi, 1991); for undergraduates involved in research programs (Ishiyama, 2007; Kardash, 2000); and for underrepresented minority students (Lee, 1999; Santos & Reigadas, 2002). Most of the literature focuses on cognitive and affective gains for the student, such as increased retention rates, higher grade point averages, and greater clarity of academic and career goals. Even though research has demonstrated that mentoring relationships have mutual benefits for both the mentor and the protégé (Newby & Heide, 2008), evidence documenting faculty motivation to become mentors or the benefits of mentorship for faculty is mainly anecdotal or focused on single programs (Campbell & Campbell, 1997; Kardash, 2000).

In a description of a faculty mentorship program at one comprehensive university, Redmond (1991) notes that involvement in “planned mentoring” and greater interaction with students may reduce professors’ stereotypes about different students and nurture perceptions of URM students as resourceful and intelligent. Such outcomes may not be sufficient for faculty who devote time to mentoring undergraduates in research. In her guide for designing an effective mentoring program, Redmond underscored the need for institutional commitment in the form of policy statements, space, personnel, and financial support. Additionally, Redmond suggests that serving as a mentor be recognized as service and considered positively in promotion and tenure reviews. Whether mentoring is recognized as service or an additional component of teaching,

incentivizing this behavior can attract faculty who may be worried about devoting limited time to mentorship.

As alluded to above, several studies have discussed the disincentives that faculty have to become good mentors to students (Johnson, 2002; Merkel, 2001; Prince, Felder, & Brent, 2007). These obstacles can exist at multiple levels: institutional, departmental, and individual (Johnson, 2002). Many colleges and universities implement “university accounting systems that reward faculty exclusively for funded research and publications, typically at the cost of teaching and mentoring” (Johnson, 2002, p. 90). In other words, with a reduced likelihood to be rewarded by the institution for their work with students, faculty may instead focus their efforts in areas that offer demonstrated, tangible rewards. Likewise, Johnson notes that departments often provide little, if any, incentive to mentor students, as many departments or units within a higher education institution do not offer faculty financial compensation, reduced course loads, or accelerated opportunities to achieve tenure for being excellent mentors.

In addition to the institutional and departmental disincentives, faculty also may be discouraged from becoming mentors to undergraduates by few opportunities to establish meaningful relationships with students. Johnson (2007) notes that large class sizes and high undergraduate student-faculty ratios make connecting with and mentoring individual students more challenging. Moreover, the undergraduate experience in certain disciplines is brief, as some students delay declaring a major for a year or more. Finally, undergraduate students tend to rely on faculty to establish mentoring relationships, as many students lack the self-awareness or assertiveness to find a mentor on their own (Johnson, 2007).

*Organizational Citizenship and Social Exchange Theory*

Given that faculty workload demands and institutional disincentives tied to involving undergraduates in research may discourage faculty from including undergraduates on their research projects, we draw from a model of organizational citizenship behavior to understand why some faculty may choose to work with undergraduates on research despite these potential barriers. McManus and Russell (1997) describe organizational citizenship as “exerting more effort on the job than is required or expected by formal role prescriptions” (p. 148). Such a framework is appropriate for studies of faculty members’ propensity to work with students, as establishing a collaborative research relationship with undergraduate students represents an endeavor that exceeds most institutions’ expectations of faculty. The link between a faculty member’s decision to mentor a student and organizational citizenship behavior becomes more apparent when considering that “mentors are providing assistance to protégés without that behavior being mandated or compensated by the organization” (McManus & Russell, 1997).

Early research on organizational citizenship behavior identified five dimensions of this construct: altruism, conscientiousness, sportsmanship, courtesy, and civic virtue (Organ, 1988). Altruism relates to individuals’ desire to help others in face-to-face settings, such as volunteering for additional duties or helping to orient others within the workplace. Conscientiousness corresponds to following the norms of the organization, and sportsmanship relates to whether individuals maintain a positive attitude and avoid complaining about trivial matters. Finally, courtesy connects to the extent to which employees collaborate and consult with others before making a decision, and the dimension of civic virtue corresponds to the frequency with which individuals remain updated on news affecting the organization.

Given the complexity of the five dimensions of organizational citizenship behaviors identified by early scholars, Organ and Ryan (1995) condensed these traits into two primary components: (1) actions and decisions targeted for certain individuals and (2) activities directed at an organization. Individuals may have a greater inclination to perform functions outside their prescribed responsibilities if they are satisfied with their job and have a strong commitment to their organization or institution (McManus & Russell, 1997). Past studies have linked faculty members' job satisfaction and overall morale with their commitment to their work (Bland et al., 2005; Johnsrund & Rosser, 2002; Mamiseishvili & Rosser, 2010). Similarly, research suggests that if individuals believe that a role outside of their prescribed duties, such as mentoring, is actually an integral part of their work, they are more likely to voluntarily engage in the activity (Herzberg, 1966; Judge, Bono, Thoresen, & Patton, 2001; McManus & Russell, 1997).

Although the organizational citizenship framework generally has been used in the management and human resource literature to examine mentorship relationships in the corporate world, it can be extended to higher education. Faculty members who have a stronger commitment to their institution, whether because they believe their values are congruent with the institution or because they believe in the direction and overall mission of their college or university, may have an increased likelihood to go beyond their official job responsibilities by serving in a mentoring role to undergraduate students. This congruence of beliefs and values leads to a greater sense of faculty morale, which may prompt faculty to become even more engaged in their work and decide to mentor undergraduates (Doherty, 1988; Johnsrud & Rosser, 2002), and a mentorship relationship may come in the form of an undergraduate research experience with faculty. Likewise, faculty who have a more positive view of undergraduates at

their institution and spend more time with undergraduates may have an increased probability of wanting to work with undergraduates on faculty-directed research projects.

Faculty members' decision to include undergraduates on their research project can also be understood through the lens of social exchange theory. Linked to the framework of organizational citizenship, social exchange theory suggests that individuals choose to engage in relationships that they expect to offer beneficial personal outcomes (Emerson, 1981; Lawler & Thye, 1999). When entering into these relationships, individuals weigh the perceived costs and benefits of such a connection, as the parties involved exchange something of value (Emerson, 1981). In the case of faculty including undergraduates on their research project, faculty offer undergraduate students time and knowledge whereas undergraduate research participants likely offer faculty limited labor. Social exchange theory does not suggest that all relationships offer an equal sense of reciprocity to both parties involved, which can create a power dynamic between the dyads (Emerson, 1981).

Although generally applied to romantic relationships, social exchange theory has been utilized in studies on mentoring (Gibb, 1999; Hegstead, 1999). Griffin (2008) applied this framework in a study of the mentoring relationships between Black faculty and their students. Considering faculty members' work with undergraduate students on research in the broader context of their responsibilities and obligations to the institution, faculty may choose to involve undergraduate students on research projects after weighing the potential high costs and limited benefits of entering into such a relationship. Faculty members who perceive little reward for themselves, have limited interest in mentoring, or simply have limited time to invest in a mentoring relationship with an undergraduate student may be disinclined to include undergraduates on their research projects.

## Methods

Drawing from the literature and the frameworks of organizational citizenship behavior and social exchange theory discussed above, this study addresses the following research questions:

1. To what extent do background characteristics, professional status, teaching and scholarly activities, and perceptions of the institutional climate predict STEM faculty members' likelihood to involve undergraduate students in their research projects?
2. Controlling for individual characteristics, to what extent do institutional type, selectivity, and faculty's average perception of institutional priorities account for the variation across colleges and universities in STEM faculty members' average probability of involving undergraduate students in their research projects?

### *Sample*

The sample for this study comes from the 2007-2008 Faculty Survey administered by UCLA's Higher Education Research Institute (HERI). Every three years, HERI administers a survey to a national sample of faculty across all disciplines and from all types of institutions. The survey collects information about the demographics of faculty, faculty members' responsibilities at their respective institutions, career trajectories, goals and priorities related to undergraduate education, and perceptions of institutional priorities, among other items (see DeAngelo, Hurtado, Pryor, Kelly, Santos, and Korn, 2009 for additional details about the survey and its methodology).

Funding from the National Institutes of Health (NIH) and National Science Foundation (NSF) allowed for a supplemental sample of STEM faculty to participate in the survey. This sample included institutions that have strong reputations for conferring high numbers of STEM

baccalaureate degrees and a group of minority-serving institutions that do not regularly collect such data on their faculty. Within these institutions, we invited all STEM faculty to participate in the survey. When combined with the larger administration of the Faculty Survey through HERI, the resulting supplemental sample of faculty included 6,036 STEM faculty members from 205 institutions.

Because this study seeks to identify the variables that predict faculty members' decision to involve undergraduate students on their research project, we removed respondents who indicated that their primary responsibility at their institution was administration and respondents who said that they had no contact with undergraduate students. After deleting cases with missing data for the outcome and for key demographic characteristics, such as gender and race/ethnicity, we arrived at a final analytic sample of 4,765 STEM faculty within 193 colleges and universities. For the current study, the faculty data were merged with 2007 data from the Integrated Postsecondary Education Data System.

### *Variables*

The dependent variable for this study is a dichotomous measure that asked: "During the past two years, have you engaged undergraduates on your research project?" Table 1 provides a complete list of the coding schemes for the dependent and independent variables used in the analyses. To ease interpretation, we grouped our independent variables into blocks according to prior literature and our conceptual framework. The first block included demographic control variables, including sex, race, and native language. Asian American, Latino, Black, and Native American represent four separate dichotomous variables with White as the reference group.

In the second block of variables, we accounted for characteristics of faculty members' professional career, including tenure status, amount of time they have worked at their present

institution, and rank. The length of time faculty have worked at their present institution was derived from taking the difference between the year of appointment and 2008, as the vast majority of faculty completed this survey in the spring and summer of 2008. For faculty rank, associate professor served as the reference group with professor, assistant professor, lecturer, and instructor representing dichotomous variables. Among disciplines, we controlled for faculty who worked in engineering and computer science departments, health science departments, or physical science departments, and we used the life sciences as the reference group.

Our analyses also accounted for a host of scholarly and teaching activities, including several variables representing whether faculty have taught an honors course, an interdisciplinary course, a course exclusively on the Internet, or a first-year seminar. Additionally, we controlled for the number of graduate courses that faculty taught and the hours per week they were scheduled to teach during the term in which they completed the survey. Prior research has suggested that faculty who spend more time teaching may have less time to devote to research or provide the mentorship and oversight necessary to work with undergraduates on research projects (Fairweather, 2002; Schuster & Finkelstein, 2006). Further, we control for the amount of time faculty spend on research each week, the extent to which they mentor new faculty, and whether they advised student groups involved with volunteer work. Mentoring new faculty and advising student groups served as proxies for faculty members' commitment to mentorship in their work, as such a commitment may translate into an increased likelihood of mentoring undergraduate students through engaging them in research opportunities. Furthermore, such behavior may be indicative of a greater propensity to engage in organizational citizenship, as faculty members voluntarily decide to mentor new faculty or work with undergraduate student groups.

The model further examined the predictive power of faculty members' productivity, as measured by the number of published pieces across different media, and the extent to which faculty secure funding to support their research. Receiving fiscal support for research may have a positive association with faculty members' likelihood to involve undergraduates in their research projects, as funding may enable faculty to pay undergraduates or may require them to include undergraduates on their research team as part of a training component (Einarson & Clarkberg, 2004). NIH and NSF often have opportunities, or even requirements, for faculty to include training components in research grants, and these components are designed to encourage faculty to include undergraduate students on their research teams. We also considered the predictive power of faculty members' goals for undergraduate education on their likelihood of involving undergraduates in their research projects. Specifically, we included the goals of promoting students' writing ability, helping students evaluate the quality and reliability of information, encouraging habits of mind for learning, and enhancing students' social understanding. Encouraging students' habits of mind for learning and enhancing students' social understanding represented latent constructs, and Table 2 includes additional information on these factors. We used principal axis factoring with promax rotation to generate all factors used in the analyses.

The final block of faculty-level variables included measures of faculty members' perceptions of the institutional climate. We examined the association between the outcome and a factor measuring faculty's perception that the institution places a high priority on advancing institutional prestige. Additionally, the analyses included respondents' opinions regarding whether the institution rewards them for their efforts in working with underprepared students, the extent to which respondents feel students are well-prepared academically, and the extent to which faculty feel their colleagues in their department value their research.

Finally, our analyses accounted for institution-level measures of the context in which faculty work. We included dichotomous measures corresponding to whether the institution is an historically Black college or university (HBCU), a private institution, a liberal arts college or doctoral/research university (comprehensive master's is the reference group), and whether the institution houses a medical center. Additionally, we included a measure of institutional selectivity, which we calculated based on the average SAT scores of entering students. Finally, we included two aggregated measures from the faculty survey: the extent to which faculty believe the institution places a high priority on advancing prestige and the extent to which faculty believe research is important.

#### *Missing Data*

Before proceeding to our multivariate analyses to predict faculty members' likelihood of involving undergraduate in their research projects, we analyzed the extent to which data were missing on our independent variables. We deleted cases that had missing data on the outcome variable, demographic characteristics, and dichotomous variables. After removing these cases, we utilized the expectation-maximization (EM) algorithm to impute values for cases with missing data. McLachlan & Krishnan (1997) suggest that the EM algorithm provides a more accurate estimation of values for missing data than other less robust methods, including mean replacement. Through the use of maximum likelihood estimates, the EM algorithm replaces missing values for specified variables in the dataset; however, McLachlan and Krishnan (1997) recommend that analysts use this method only when a small proportion of data is missing for a given variable. In our sample, no variable had more than 7% of cases with missing data.

*Analyses*

The primary analytic technique guiding this study was hierarchical generalized linear modeling (HGLM). HGLM is the most appropriate statistical technique to use when analyzing multi-level data to predict a dichotomous outcome (Raudenbush & Bryk, 2002). Our data have a clustered design, as faculty are nested within institutions; HGLM accounts for the inherent hierarchical nature of the data and provides robust standard errors to reduce the likelihood of Type I statistical errors (Raudenbush & Bryk, 2002). Furthermore, because this method appropriately partitions variance in the outcome between individuals (faculty) and groups (institutions), we were able to more accurately estimate the unique effects of institutional contexts on faculty members' likelihood to involve undergraduate students in research projects.

In building models within HGLM, analysts must ensure that the outcome significantly varies across institutions. We analyzed the random variance component from the fully unconditional model, which is a model without any predictors, to determine whether faculty's average probability of involving undergraduates in research significantly differed across colleges and universities. The fully unconditional model suggested that institutions significantly differed in the average likelihood that faculty involved undergraduates in research. Given such variation, we proceeded with building the level-one model, which is shown in Equation 1.

$$\begin{aligned} \text{Log} \left[ \frac{\Phi_{ij}}{1 - \Phi_{ij}} \right] = & \beta_{0j} + \beta_{1j} (\text{DEMOGRAPHIC CHARACTERISTICS})_{ij} & (1) \\ & + \beta_{2j} (\text{PROFESSIONAL CAREER})_{ij} \\ & + \beta_{3j} (\text{TEACHING AND SCHOLARLY ACTIVITIES})_{ij} \\ & + \beta_{4j} (\text{PUBLICATIONS AND FUNDING})_{ij} \\ & + \beta_{5j} (\text{GOALS FOR UNDERGRADUATES})_{ij} \\ & + \beta_{6j} (\text{INSTITUTIONAL CLIMATE})_{ij} \end{aligned}$$

where the term on the left side of the equation refers to the likelihood that faculty member  $i$  in institution  $j$  involved undergraduates in his or her research project. The terms  $B_{1j}$ – $B_{6j}$  represent the individual coefficients corresponding to each variable in the model. For simplicity's sake, we do not present every variable in our model in Equation 1; instead, demographic characteristics, professional career, teaching and scholarly activities, publications and funding, goals for undergraduates, and institutional climate refer to the blocks of variables previously described and presented in Table 1. We allowed the intercept for Equation (1),  $\beta_{0j}$ , to vary across institutions because the fully unconditional model suggested that the average probability that faculty involved undergraduates in their research significantly differed across institutions. To examine the factors that account for this variation across colleges and universities, we constructed a model for institution-level variables, which is given by Equation 2.

$$\begin{aligned}
 B_{0j} = & \gamma_{00} + \gamma_{01} (\text{INSTITUTIONAL CHARACTERISTICS})_j & (2) \\
 & + \gamma_{02} (\text{INSTITUTIONAL SELECTIVITY})_j \\
 & + \gamma_{03} (\text{AGGREGATED FACULTY VARIABLES})_j + \mu_j
 \end{aligned}$$

where  $j$  denotes the institution. Institutional characteristics, institutional selectivity, and aggregated faculty variables refer to the blocks of variables previously described; additionally,  $\gamma_{01}$ – $\gamma_{03}$  refer to the coefficients associated with the individual variables within those blocks. Institutional selectivity was re-scaled so that a one-unit increase actually represents a 100-point increase in average institutional selectivity. Finally,  $\mu_j$  represents the randomly varying error term in the level-2 model. When utilizing multilevel modeling techniques, it is important to consider how variables are centered, as centering affects the interpretation of the intercept. We chose to grand center all continuous variables and leave all dichotomous variables uncentered

(Raudenbush & Bryk, 2002), as the focus of our study did not center around interpreting the intercept of Equation 1.

Finally, to improve interpretation of the findings, we report all of our significant results as delta-p statistics. Delta-p statistics correspond to the expected change in probability of involving an undergraduate in a faculty research project for every one-unit change in the independent variable. We relied on the recommended method by Petersen (1985) to calculate these statistics.

### *Limitations*

Before discussing the results from the HGLM analyses, it is important to note several limitations of this study. First, as with any study that analyzes secondary data, we are limited by the variables that were included on the 2007-2008 HERI Faculty Survey. For example, our outcome variable measures only whether faculty members involved undergraduate students on their research projects; therefore, we are unable to determine the extent of the undergraduates' involvement on the project or the level of engagement faculty had with these students. Similarly, the outcome variable is limited to having involved undergraduate students on faculty research projects within the last two years. Secondly, because this study analyzed cross-sectional data, we cannot infer causality. Faculty participants responded to all survey items at the same point in time; thus, we cannot conclude whether certain perceptions or actions led to faculty members' decision to include undergraduate students on research projects or whether such engagement prompted the perceptions and experiences that faculty reported on the survey.

### Results

Table 3 presents descriptive statistics for the variables included in our analyses. Six in ten (61%) STEM faculty in our sample had involved undergraduate students in their research

projects within the last two years. About a third of the sample was female (33%), and 7% identified as Asian American or Pacific Islander, 1% as Latino, 2% as Black, and 1% as Native American. Approximately 85% of faculty in our sample indicated that they are native English speakers. Across major classifications of academic disciplines, we note that 23% of faculty in the sample worked in a life sciences department, 24% in an engineering or computer science department, 18% in a health sciences department, and 34% in a physical sciences department. Nearly 30% of respondents had earned the rank of associate professor, 23% were at the assistant professor level, and 40% were at the rank of full professor.

The descriptive statistics in Table 3 show that more than a third (37%) of faculty in our sample advised student groups involved in volunteer work, and 43% indicated that they collaborate with the local community in their teaching or research activities. Fewer than 10% of faculty respondents taught a course exclusively on the Internet, and more than 40% had taught a first-year seminar course.

Among the institutional characteristics, descriptive statistics in Table 3 show that 9% of institutions in our sample were HBCUs while 53% of colleges and universities were private. Average selectivity, as measured by average SAT composite scores of incoming students, was 1,118. Finally, we had a mix of liberal arts colleges (17%), masters comprehensive institutions (35%), and doctoral and research universities (48%).

We present the results from the HGLM analyses in Table 4, and for simplicity purposes we present only the findings from the final model, which included both faculty- and institution-level predictors. Our results suggest that the institutional context has a significant association with faculty members' probability of engaging undergraduates in their research projects. For example, faculty who worked at an HBCU had a 17.03% higher probability of involving

undergraduates on their research projects than did their colleagues at predominantly White institutions and Hispanic-serving institutions. Additionally, faculty who taught at liberal arts colleges were more than 13% more likely than their peers at masters comprehensive institutions to include undergraduate students in research. Institutional selectivity also significantly and positively predicted faculty's inclusion of undergraduates on research projects, as a 100-point increase in institutions' selectivity corresponded to a 3.50% increase in faculty members' average probability of involving undergraduates in research. The institutional variables in the model accounted for 59% of the between-institution variance in the average probability of engaging undergraduates on faculty research projects.

Considering individual predictors of faculty members' decision to include undergraduate students in research projects, demographic characteristics did not have a significant association with the outcome. In contrast, several of the professional, career-related characteristics significantly predicted faculty members' likelihood of engaging undergraduates in their research. For example, faculty who had worked at an institution longer tended to have a lower probability of engaging undergraduate students in research. Every additional year at the institution was associated with a small but significant 0.48% reduction in probability of working with undergraduates on research.

Faculty in different disciplines within STEM had significantly different likelihoods of involving undergraduates in their research. For example, faculty in engineering and computer science were approximately 17% less likely than their colleagues in life sciences departments to include undergraduates in research. This negative association doubled when comparing health sciences faculty to their peers in the life sciences, as health sciences faculty were 34.55% less likely than their colleagues in the life sciences to involve undergraduates in their research.

Furthermore, faculty in the physical sciences were nearly 20% less likely than respondents in the life sciences to include undergraduates in research.

Turning to teaching and scholarly activities, our results demonstrate a significant and positive association between teaching an honors course ( $\Delta p = 9.63\%$ ) or an interdisciplinary course ( $\Delta p = 5.76\%$ ) and involving undergraduates in a faculty member's research project. By contrast, faculty who taught more graduate courses tended to have a lower likelihood of also reporting that they had involved undergraduate students in a research project within the last two years ( $\Delta p = -3.69\%$ ). Respondents who reported that they collaborated with the local community in their teaching or research were approximately 8% more likely to have undergraduates involved on their research projects. Likewise, spending more time each week engaged in research activities had a significant and positive association with inclusion of undergraduate students in faculty-directed research projects. Finally, respondents who indicated that they advised student groups involved in volunteer work had a 7.08% greater likelihood of engaging undergraduates in research than their peers who did not advise such student groups.

In terms of faculty respondents' level of productivity and funding sources, we found that faculty who published more journal articles throughout their careers also tended to be significantly more likely to include undergraduates in their research projects. In contrast, the findings indicate that faculty who published more books, manuals, or monographs over the course of their careers tended to have a lower probability of engaging undergraduate students in research. The number of recent publications (within the last two years) did not have a significant association with the outcome variable.

Related to publishing, the results in Table 4 suggest that faculty who secured funding for their research had significantly higher probabilities of also engaging undergraduate students in

research. Respondents who had received funding from foundations were nearly 9% more likely to engage undergraduates in their research projects compared to their peers who did not receive grants from foundations. Likewise, securing funding from business or industry corresponded to a 7.73% increase in probability of including undergraduates in research. State or federal government grants, however, had a strong association with faculty's decision to include undergraduate students on research projects, as faculty who had received a grant from a state or federal agency were 13.22% more likely to have undergraduate students working on their research projects compared to their colleagues who did not have state or federal research dollars.

Results connected to faculty members' goals for undergraduate education were mixed. Feeling strongly about promoting students' ability to write effectively, helping students evaluate the quality and reliability of information, and developing students' social understanding had no significant association with respondents' probability of having involved undergraduate students in one of their research projects within the last two years; however, the factor measuring faculty members' commitment to encouraging students' development of habits of mind for learning had a significant and positive association with the outcome. For every one standard deviation increase in the factor, faculty members' probability of including undergraduate students on a research project increased by 6.64%.

Finally, three of the six perceptions of institutional climate significantly predicted the outcome variable. Faculty who believe that students at their institution are well-prepared academically tend to have a higher probability of including undergraduate students on their research projects ( $\Delta p = 3.50\%$ ). Likewise, respondents who reported that faculty at their institution are strongly interested in the academic problems of students ( $\Delta p = 3.65\%$ ).

Additionally, faculty who felt that their departmental colleagues valued their research tended to be significantly more likely to include undergraduates in their research.

### Discussion

In this study we utilized the frameworks of social exchange theory and organizational citizenship behavior to understand why faculty members decide to involve undergraduate students on their research projects. To that end, we considered how institutional contexts and individuals' behaviors and perceptions affect faculty members' probability of deciding to include undergraduates on research projects. From an institutional perspective, we found a large and significant gap in the probability of working with undergraduate students on faculty-directed research projects between faculty at HBCUs and their colleagues at PWIs and HSIs. Faculty who worked at HBCUs were significantly more likely to engage undergraduates in research than their peers at PWIs and HSIs. This finding connects to other research that has suggested that HBCUs offer their students a more supportive, collaborative environment compared to students who do not attend HBCUs (Nelson Laird, Bridges, & Morelon-Quainoo, 2007). This finding also connects to work by Allen (1992) and Hurtado, Cabrera, Lin, Arellano, and Espinosa (2009) that found higher levels of support and engagement among both students and faculty within HBCUs. Hurtado (2003) suggested that HBCUs have unique student-centered mission, and this mission may be driving faculty members' decision to include undergraduates on their research projects. This supportive environment appears to extend to faculty members' willingness to mentor undergraduate students by providing them research opportunities.

With regard to institutional type, our findings suggest that faculty who work at liberal arts colleges tended to have significantly higher probabilities of including undergraduates on research projects than do their peers at masters comprehensive universities. Faculty who work at liberal

arts colleges generally are less known for their research productivity, as these institutions generally emphasize teaching over research and typically require faculty to teach substantially more hours each week than their colleagues at masters comprehensive or doctoral/research universities (Milem, Berger, & Dey, 2000; Schuster & Finkelstein, 2006). It may be the case that the smaller class sizes and more intimate campus environments allow faculty at liberal arts colleges to connect with undergraduates in ways that their peers at larger, more research-intensive institutions cannot, and these connections increase faculty members' willingness to involve undergraduates on their research projects. Furthermore, faculty at liberal arts institutions generally have few, if any, graduate students with whom they can collaborate on research, so any faculty-student research projects likely involve undergraduates.

The third and final significant institutional predictor in our model was selectivity. Faculty at more selective institutions had significantly higher probabilities of including undergraduates on their research projects, and this finding may connect to the overall preparation of students. Similar to the individual-level finding that showed a positive association between faculty members' perception of students' academic preparedness and their likelihood to involve students in research, the positive association between selectivity and involving undergraduate students in research may speak to faculty members' sense that well-prepared students may need less oversight and orientation to the research project. If better-prepared students can adapt quickly to a research project, they may indeed promote, rather than hinder, faculty members' research productivity (Harvey & Thompson, 2009). Additionally, faculty at more selective institutions typically have a larger pool of high-achieving students from which to draw for their research projects.

Perhaps most strongly connected to the framework of organizational citizenship behavior are the findings related to the association between measures of institutional climate and faculty members' likelihood to work with undergraduates on research. Faculty who indicated that their colleagues in their department valued their research tended to have an increased likelihood of including undergraduates in research. Likewise, reporting that faculty at the institution are strongly interested in undergraduates' academic problems significantly and positively predicted faculty members' inclusion of undergraduate students in research projects. These findings, as well as feeling that students at the institution are well-prepared, relate to having a positive attitude regarding the work (or campus) environment, which organizational citizenship behavior theory suggests increases employees' likelihood to assume responsibilities outside their prescribed duties (McManus & Russell, 1997; Organ & Ryan, 1995). Faculty who retain a generally positive or optimistic attitude about the undergraduate students on their campus and feel valued by their colleagues are more likely to take the extra step of working with undergraduates on research and potentially mentoring those students even if reward system and productivity disincentives exist. This finding also supports results from previous studies that connect faculty morale and job satisfaction to faculty members' commitment to their work (Johnsrud & Rosser, 2002; Rosser, 2004).

Similarly, one of the faculty goals related to undergraduate education had a significant and positive association with faculty members' likelihood of including undergraduate students on research projects. Faculty who felt more strongly about improving students' habits of mind for learning tended to have a significantly higher probability of involving undergraduates in research. This goal may demonstrate faculty members' commitment to undergraduate education, and the significant and positive association between it and the decision to include undergraduate

on faculty-directed research projects may indicate that faculty understand the potential benefits of undergraduate research for students (Espinosa, 2009; Hunter, Laursen, & Seymour, 2006; Seymour, Hunter, Laursen, & Deantoni, 2004). Additionally, through the lens of organizational citizenship behavior, faculty members' commitment to undergraduate education may prompt them to want to improve undergraduate students' experience regardless of the presence of any tangible incentive to do so.

Spending more face time with undergraduate students generally corresponded to an increased probability of including them on research projects. Faculty who taught honors or interdisciplinary courses or who advised student groups connected to volunteerism also tended to be significantly more likely to engage undergraduates in research. Having more contact with undergraduates, particularly in more intimate settings like honors classes or student groups, may improve faculty members' perceptions of working with undergraduates on research, particularly as they relate to any perceived disincentives of reduced productivity (Harvey & Thompson, 2009; Prince, Felder, & Brent, 2007). Furthermore, such perceptions of undergraduates may improve faculty members' job satisfaction (Rosser, 2004) and general morale (Johnsrud & Rosser, 2002), which organizational citizenship theory suggests enhances individuals' likelihood to perform duties outside their prescribed responsibilities.

Not surprisingly, securing funding for research had a significant, positive association with involving undergraduates in faculty-directed research projects. Although undergraduates may pursue research opportunities for the hands-on training and mentorship they expect to receive, many also use such opportunities as a way to earn supplemental funding toward financing their undergraduate degree. Faculty who secure research dollars have a greater potential of being able to offer undergraduates not only the research experience but also the

financial support students seek. Additionally, our findings suggest that faculty who had secured funding from state or federal agencies were nearly twice as likely as their peers who received funding from foundations or industry to engage undergraduates in research. This substantial difference between sources of funding may relate to the fact that some government-sponsored grants have an undergraduate training requirement through which faculty receive additional funds mandated to be spent on research opportunities for undergraduate students. NSF and NIH typically provide funding to faculty for including training components in research grants as a way to incentivize faculty to include undergraduates on their project. From a broader perspective, these training components serve as an indirect way in which NSF and NIH aim to expand undergraduate research opportunities in addition to the direct funding these and other organizations provide for structured undergraduate research programs.

Turning toward demographic and disciplinary variables, we found no significant differences across sex, race, or native language, but we did find substantial differences across STEM disciplines in faculty members' probability of involving undergraduates in research. Faculty in engineering and computer science, health sciences, and physical sciences departments had significantly lower likelihoods of working with undergraduates on research projects compared to their colleagues in the life sciences. These differences persisted even after accounting for issues related to faculty members' ability to secure funding for their research, suggesting that faculty in the life sciences are either more willing to conduct research with undergraduates, on the whole, or that the types of research done in the life sciences are more conducive to including undergraduate students.

### Conclusions and Implications

Given the often limited funding for formal structured undergraduate research programs, our findings suggest that institutional administrators who view undergraduate research as an important component of STEM education would be well-served to try to increase faculty members' commitment to their institution and to undergraduate education, or to hire faculty who explicitly possess these commitments. Our findings showed that faculty who believe in strengthening undergraduate education by helping undergraduate students achieve key goals also tended to be more likely to report having worked with undergraduates on research projects within the previous two years. Similarly, faculty who had more positive perceptions of the preparation of undergraduate students also tended to have significantly higher probabilities of involving undergraduates in their research.

Although our dataset lacked variables related to faculty members' perceptions of their institution's reward and incentive structures, several findings from our analyses suggest that reshaping the incentive structure may increase faculty members' probability of involving undergraduates in research. For example, faculty who volunteered to advise student groups were significantly more likely to include undergraduates in research. Likewise, respondents who taught interdisciplinary courses or worked with the community in their research and teaching activities also tended to be more likely to include undergraduates in research. These activities may merely relate to an individual faculty member's proclivity to exceed core responsibilities at the institution, but by incentivizing activities connected to mentorship, institutions have an opportunity to increase faculty members' engagement with undergraduate students. Organizations such as Campus Compact have formed STEM groups that recognize and emphasize the importance of mentorship and social action in scientific research, and colleges and

universities have an opportunity to follow the lead of these organizations. By incentivizing faculty engagement with undergraduate students and the local community, institutions have the potential to increase faculty members' likelihood to involve undergraduates in research, and such connections with faculty provide a number of benefits to students (Cole & Espinoza, 2007; Seymour et al., 2004).

Further, our analyses suggest that faculty members who feel that their research is valued by members of their department are more likely than those who do not feel this way to involve undergraduates on their research projects. Such an association may in part stem from an understanding or an expectation of these faculty members on that providing opportunities for undergraduates to work on their research projects will be rewarded—or has been rewarded—in their department's review and tenure process. O'Meara and Braskamp (2005) note that “eliciting greater faculty engagement with students means affecting expectations for faculty work and the structures and conditions of their careers” (p. 226). By expanding reward structures that “include a broadened definition of scholarship,” administrators can begin incentivizing faculty who engage regularly with students, serve as mentors, connect their research to the local community, and participate in less traditional forms of scholarship and publishing (O'Meara & Braskamp, 2005, p. 232). Given the amount of time faculty may spend facilitating the intellectual and social development of their protégés, institutions that value undergraduate education have an obligation to recognize such an investment of time and energy on the part of faculty.

By incentivizing faculty members' mentorship of undergraduate students through research experiences, college administrators can institutionalize many of the structured undergraduate research programs funded by organizations like NSF and NIH. Many of these structured programs have a limited timeframe for the funding. However, if institutions

incentivize the inclusion of undergraduates on research either through the tenure and promotion system or through institutional grants that offer undergraduate research training components, college administrators can demonstrate sustainability of undergraduate research experiences long after the funding for structured programs has expired.

Future research needs to go beyond examining what predicts faculty members' willingness to engage undergraduates in research to consider the types of opportunities for research that faculty members offer undergraduate students. The quality and type of research experiences likely varies considerably across faculty and the students with whom they work. A fuller accounting of what these research experiences involve, both in terms of faculty time and effort as well as student learning and engagement, would offer a more complex understanding as to how to incentivize faculty to offer these experiences and encourage students to take advantage of such opportunities. Institutional researchers may have the best handle on the existence of institutional structures that can support faculty research and teaching

Hurtado et al. (2008) emphasized the importance of the structure of opportunity in providing research experiences to undergraduate science students. Faculty have a role in facilitating these opportunities, particularly in institutions where formal structured programs do not exist. However, without tangible incentives to create research opportunities, many faculty may decide to involve undergraduate students in research projects solely as a result of good organizational citizenship behavior. In other words, they include undergraduates in research because they feel strongly about mentoring or because they understand the potential mutual benefits of collaborating with students. Creating institutional incentives or rewards for faculty to work with undergraduates on research will not only reward those faculty who already encourage students to work with them on research but may also provide motivation for other faculty to

begin to engage with undergraduates in this way. Relying on a few faculty members to volunteer to exceed their prescribed core responsibilities is not a sustainable way to provide research opportunities to undergraduates. For institutions to develop and sustain undergraduate research programs, they need the support of their faculty, and to get the support of faculty, institutions need to provide them with support in return.

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Table 1  
*Description of Variables and Measures*

Variables	Scale Range
<i>Demographic Characteristics</i>	
Sex	1 = male, 2 = female
Is English your native language?	1 = no, 2 = yes
Racial/Ethnic Background (White is reference group)	
Asian	0 = no, 1 = yes
Latino	0 = no, 1 = yes
Black	0 = no, 1 = yes
Native American	0 = no, 1 = yes
<i>Professional Career</i>	
Tenured	0 = no, 1 = yes
Time since appointed at present institution (in years)	Continuous, min=0, max=54
Rank (Associate Professor is reference group)	
Full Professor	0 = no, 1 = yes
Assistant Professor	0 = no, 1 = yes
Lecturer	0 = no, 1 = yes
Instructor	0 = no, 1 = yes
<i>Discipline (Life sciences)</i>	
Engineering and computer science	0 = no, 1 = yes
Health Sciences	0 = no, 1 = yes
Physical Sciences	0 = no, 1 = yes
<i>Teaching Activities</i>	
Taught an honors course (last 2 years)	1 = no, 2 = yes
Taught an interdisciplinary course (last 2 years)	1 = no, 2 = yes
Taught a course exclusively on the Internet (last 2 years)	1 = no, 2 = yes
Taught a seminar for first-year students (last 2 years)	1 = no, 2 = yes
Number of Graduate courses taught (this academic year)	Continuous, min = 0.49, max = 6
HPW teaching (actual, not credit hours) (average week during this term)	1 = none, 9 = 45+ hours
<i>Other Scholarly Activities</i>	
Collaborated with the local community in research/teaching (last 2 years)	1 = no, 2 = yes
Advised student groups involved in service/volunteer work (last 2 years)	1 = no, 2 = yes
HPW Research and scholarly writing (average week during this term)	1 = none, 9 = 45+ hours
Extent: engage in academic work that spans multiple disciplines	1 = not at all, 3 = to a great extent
Extent: mentor new faculty	1 = not at all, 3 = to a great extent
<i>Publications and Funding</i>	
Number of articles published in academic or professional journals (career)	1 = none, 7 = 51+
Number of published books, manuals, or monographs (career)	1 = none, 7 = 51+
Number of writings published/accepted for publication ( last 2 years)	1 = none, 7 = 51+

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Received funding for your work from: Foundations ( last 2 years)	1 = no, 2 = yes
Received funding for work from: State/federal government ( last 2 years)	1 = no, 2 = yes
Received funding for your work from: Business or industry ( last 2 years)	1 = no, 2 = yes
<i>Goals for Undergraduates</i> (importance of goals for undergraduate students)	
Promote ability to write effectively	1 = not important, 4 = essential
Help students evaluate the quality and reliability of information	1 = not important, 4 = essential
Encourage student Habits of Mind for Learning (factor)	Continuous, min=-4.15, max=1.37
Goal for undergrads: Enhance social understanding (factor)	Continuous, min=-1.89, max=1.62
<i>Institutional Climate</i>	
Institutional Priority Prestige (factor)	Continuous, min=-2.33, max=1.33
Faculty are rewarded for their efforts to work with underprepared students (at this institution)	1= not descriptive, 3 = very descriptive
Faculty feel that most students are well-prepared academically (at this institution)	1= not descriptive, 3 = very descriptive
Faculty here are strongly interested in the academic problems of undergraduates (at this institution)	1= not descriptive, 3 = very descriptive
My research is valued by faculty in my department	1 = Disagree strongly, 4 = Agree strongly
My values are congruent with the dominant institutional values	1 = Disagree strongly, 4 = Agree strongly
There is adequate support for faculty development	1 = Disagree strongly, 4 = Agree strongly
<i>Institutional Characteristics</i>	
Faculty average: importance of research	Continuous, min=1.50, max=4.00
Faculty average: Institutional priority is prestige	Continuous, min=-2.20, max=1.17
HBCU	1 = no, 2 = yes
Institution has a medical center	1 = no, 2 = yes
Control of institution	1 = public, 2 = private
Liberal Arts Institution (Carnegie) (masters comp. is the reference group)	0 = no, 1 = yes
Doctoral Institution (Carnegie)	0 = no, 1 = yes
Institutional Selectivity	Continuous, min=838, max=1467

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Table 2  
*Descriptive Statistics (Faculty N = 4,832, Institutional N = 194)*

	Mean	S.D.	Min	Max
<i>Demographic Characteristics</i>				
Sex	1.33	0.47	1.00	2.00
Is English your native language?	1.85	0.36	1.00	2.00
Asian	0.07	0.26	0.00	1.00
Latino	0.01	0.10	0.00	1.00
Black	0.02	0.14	0.00	1.00
Native American	0.01	0.11	0.00	1.00
<i>Professional Career</i>				
Tenured	0.65	0.48	0.00	1.00
Time since appointed at present institution	14.20	10.76	0.00	54.00
Full professor	0.40	0.49	0.00	1.00
Assistant professor	0.23	0.42	0.00	1.00
Lecturer	0.04	0.19	0.00	1.00
Instructor	0.04	0.20	0.00	1.00
<i>Discipline</i>				
Engineering and computer science	0.24	0.43	0.00	1.00
Health sciences	0.18	0.38	0.00	1.00
Physical sciences	0.34	0.47	0.00	1.00
<i>Teaching Activities</i>				
Taught an honors course	1.18	0.39	1.00	2.00
Taught an interdisciplinary course	1.40	0.49	1.00	2.00
Taught a course exclusively on the Internet	1.09	0.29	1.00	2.00
Taught a seminar for first-year students	1.21	0.41	1.00	2.00
Number of graduate courses taught	1.83	1.06	1.00	6.00
HPW Scheduled teaching (actual, not credit hours)	3.27	1.28	1.00	9.00
<i>Other Scholarly Activities</i>				
Collaborated with the local community in research/teaching	1.43	0.50	1.00	2.00
Advised student groups involved in service/volunteer work	1.37	0.48	1.00	2.00
HPW research and scholarly writing	3.89	2.12	1.00	9.00
Extent: Engage in academic work that spans multiple disciplines	2.20	0.68	1.00	3.00
Extent: Mentor new faculty				
<i>Publications and Funding</i>				
Number of articles published in academic or professional journals (career)	4.74	1.88	1.00	7.00
Number of published books, manuals, or monographs (career)	1.51	0.85	1.00	7.00
Number of professional writings published/accepted for publication in the last two years	2.84	1.35	1.00	7.00
Received funding for your work from: Foundations	1.28	0.45	1.00	2.00
Received funding for your work from: State or federal government	1.55	0.50	1.00	2.05
Received funding for your work from: Business or industry	1.25	0.43	1.00	2.00

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<i>Goals for Undergraduates</i>				
Promote ability to write effectively	3.52	0.63	1.00	4.00
Help students evaluate the quality and reliability of information	3.61	0.57	1.00	4.00
Encourage student Habits of Mind for Learning (factor)	-0.01	0.92	-4.15	1.37
Goal for undergrads: Enhance social understanding (factor)	-0.05	0.90	-1.89	1.62
<i>Institutional Climate</i>				
Institutional Priority Prestige (factor)	0.00	0.91	-2.33	1.33
Faculty are rewarded for their efforts to work with underprepared students	1.49	0.60	1.00	3.00
Faculty feel that most students are well-prepared academically	2.40	0.82	1.00	4.00
Faculty here are strongly interested in the academic problems of undergraduates	3.18	0.72	1.00	4.00
My research is valued by faculty in my department	2.97	0.82	1.00	4.00
My values are congruent with the dominant institutional values	2.88	0.76	1.00	4.00
There is adequate support for faculty development	2.75	0.78	1.00	4.00
<i>Institutional Characteristics</i>				
Faculty average: importance of research	3.13	0.47	1.50	4.00
Faculty average: importance of teaching	3.69	0.21	3.00	4.00
Faculty average: Institutional priority is prestige (factor)	-0.12	0.52	-2.20	1.17
HBCU	1.09	0.28	1.00	2.00
Institution has a medical center	1.11	0.31	1.00	2.00
Control of institution	1.53	0.50	1.00	2.00
Liberal Arts Institution (Carnegie)	0.35	0.48	0.00	1.00
Doctoral Institution (Carnegie)	0.48	0.50	0.00	1.00
Institutional Selectivity	11.18	1.54	8.38	14.76

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Table 3  
*Multi-Item Factors*

Scale & Items	Factor Loadings
<u>Encourage student Habits of Mind for Learning</u>	$\alpha = .841$
<i>In your interactions with undergraduates, how often do you encourage them to:*</i>	
Seek alternative solutions to a problem	.65
Evaluate the quality or reliability of information they receive	.64
Explore topics on their own, even though it was not required for a class	.61
Seek feedback on their academic work	.60
Seek solutions to problems and explain them to others	.59
Take risks for potential gains	.58
Support their opinions with a logical argument	.57
Look up scientific research articles and resources	.56
Acknowledge failure as a necessary part of the learning process	.55
Revise their papers to improve their writing	.53
Ask questions in class	.47
<i>*1=Not at all, 2=Occasionally, 3=Frequently</i>	
<u>Institutional Priority Prestige</u>	$\alpha = .787$
<i>Indicate how important you believe each priority listed below is at your college/university**</i>	
To enhance the institution's national image	.84
To increase or maintain institutional prestige	.78
To hire faculty stars	.69
To pursue extramural funding	.49
<i>**1=Low priority, 2=Medium priority, 3=High priority, 4=Highest priority</i>	
<u>Goal for undergraduates: Enhance social understanding</u>	$\alpha = .788$
<i>Indicate the importance to you of each of the following education goals for undergrad students***</i>	
Enhance students' knowledge of and appreciation for other racial/ethnic groups	.83
Encourage students to become agents of social change	.76
Enhance students' self-understanding	.64
<i>***1=Not important, 2=Somewhat important, 3=Very important, 4=Essential</i>	

Table 4  
*Hierarchical Generalized Linear Modeling (HGLM) Results for Faculty Propensity to Include Undergraduates on their Research Project(s)*

Faculty N = 4,832, Institutional N = 194	B	S.E.	$\Delta$ -P	Sig.
<i>Demographic Characteristics</i>				
Your Sex	-0.09	0.11		0.62
Is English your native language?	0.11	0.17		0.34
Asian	0.02	0.27		0.84
Latino	0.79	0.78		0.28
Black	0.13	0.37		0.78
Native American	-0.09	0.49		0.88
<i>Professional Career</i>				
Tenured	0.08	0.22		0.72
Time since appointed at present institution	-0.02	0.01	-0.48%	0.00
Professor	-0.10	0.15		0.48
Assistant Professor	0.30	0.25		0.23
Lecturer	-0.54	0.40		0.18
Instructor	-0.61	0.39		0.12
<i>Discipline</i>				
Engineering and computer science	-0.69	0.14	-17.04%	0.00
Health sciences	-1.47	0.16	-34.55%	0.00
Physical sciences	-0.81	0.11	-19.97%	0.00
<i>Teaching Activities</i>				
Taught an honors course	0.43	0.16	9.63%	0.01
Taught an interdisciplinary course	0.25	0.11	5.76%	0.02
Taught a course exclusively on the Internet	-0.24	0.19		0.21
Taught a seminar for first-year students	0.17	0.15		0.14
Number of undergraduate courses taught this term	0.07	0.05		0.17
Number of graduate courses taught	-0.15	0.06	-3.69%	0.01
HPW scheduled teaching (actual, not credit hours)	0.08	0.05		0.13
<i>Other Scholarly Activities</i>				
Collaborated with the local community in research/teaching	0.35	0.12	7.94%	0.00
Advised student groups involved in service/volunteer work	0.31	0.12	7.08%	0.01
HPW Research and scholarly writing	0.21	0.04	4.87%	0.00
Extent: engage in academic work that spans multiple disciplines	0.24	0.09	5.51%	0.01
Extent: mentor new faculty	0.22	0.09	5.09%	0.03
<i>Publications and Funding</i>				
Number of articles published in academic/professional journals (career)	0.19	0.05	4.41%	0.00
Number of published books, manuals, or monographs (career)	-0.16	0.08	-3.87%	0.04
Number of professional writings published/accepted for publication in the last two years	0.11	0.08		0.14
Source of stress: Research or publishing demands	0.38	0.09	8.58%	0.00
Received funding for your work from: Foundations	0.38	0.13	8.58%	0.01

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Received funding for your work from: State or federal government	0.61	0.13	13.22%	0.00
Received funding for your work from: Business or industry	0.34	0.14	7.73%	0.02
<i>Goals for Undergraduates</i>				
Promote ability to write effectively	0.10	0.10		0.31
Help students evaluate the quality and reliability of information	0.18	0.11		0.10
Encourage student Habits of Mind for Learning (factor)	0.29	0.06	6.64%	0.00
Goal for undergrads: Enhance social understanding (factor)	-0.13	0.07		0.06
<i>Institutional Climate</i>				
Institutional Priority Prestige (factor)	-0.04	0.07		0.61
Faculty are rewarded for their efforts to work with underprepared students	-0.14	0.09		0.13
Faculty feel that most students are well-prepared academically	0.15	0.07	3.50%	0.03
Faculty here are strongly interested in the academic problems of undergraduates	0.16	0.07	3.65%	0.02
My research is valued by faculty in my department	0.13	0.06	3.04%	0.05
My values are congruent with the dominant institutional values	-0.13	0.07		0.06
<i>Institutional Characteristics</i>				
Faculty average: importance of research	0.17	0.20		0.38
Faculty average: Institutional priority is prestige	-0.21	0.22		0.33
HBCU	0.82	0.41	17.03%	0.05
Institution has a medical center	-0.45	0.30		0.13
Control of institution	-0.22	0.16		0.15
Liberal Arts Institution (Carnegie)	0.60	0.20	13.03%	0.00
Doctoral Institution (Carnegie)	-0.19	0.20		0.36
Institutional Selectivity	0.15	0.05	3.50%	0.01
Intercept	-2.30	0.87		
Variance at level-2	0.06			
Explained variance at level-2	0.59			