Winter 2015

Undergraduate Research Experience Aids Progression, Graduation Rates at Texas Southern University

David Owerbach
Texas Southern University, owerbachd@tsu.edu

David Owerbach, Adebayo Oyekan, *Texas Southern University*

Undergraduate Research Experience Aids Progression, Graduation Rates at Texas Southern University, an HBCU

Undergraduate research experience has become a widely embraced practice at colleges and universities for enhancing student development and success (Lopatto 2010), and this trend has been widely supported by institutions such as the National Science Foundation (NSF) and the Howard Hughes Medical Institute (HHMI). The Survey of Undergraduate Research Experiences (SURE) has collected quantitative data on the benefits of undergraduate research since the first administration of SURE (Lopatto 2004). Based on the available data, SURE reported gains in student independence, intrinsic motivation to learn, and increased active participation in courses taken after a summer research experience (Lopatto 2007). Mentored undergraduate research has also been reported to provide students with many other advantages, including greater retention and graduation rates (Pascarella and Terenzini 1979; Jonides 1995; Nagda et al. 1998; Jones, Barlow and Villarejo 2010), higher grades (Kinkel and Henke 2006; Junge et al. 2010), and benefits in influencing career choices, including higher chances of pursuing graduate careers (Nnadozie, Ishiyama, and Chon 2001; Crowe and Brakke 2008; Taraban and Logue 2012).

Mentored undergraduate research appears to have even greater benefits for retention and graduation rates of minority populations than for non-minority students (Pascarella and Terenzini 1979; Nagda et al. 1998; Jones, Barlow and Villarejo 2010). However, most of the data on undergraduate research for African-American students were derived from student experiences at off-campus research sites (Beninson et al. 2011), and few are from research programs at Historically Black College and Universities (HBCUs). Fakayode et al. (2014) reported increased retention and graduation rates of students who participated in the undergraduate research program at Winston-Salem State University, an HBCU. However, it is unclear in their study which variables contributed to the increased retention and graduation rates.

Texas Southern University (TSU), an HBCU with approximately 6,000 undergraduate students, has an active undergraduate research program (Owerbach, Ohia and Oyekan 2013). Retention, progression, and graduation rates are low at TSU, with only 55 percent of entering freshmen persisting past the first year. Further, only 18 percent of entering freshmen progress to sophomore status in one year, and only 16.3 percent of entering freshmen graduate in six or fewer years. The current study addresses the relationship between undergraduate research and progression/graduation rates at TSU, factoring in multiple variables including GPA, race, gender, and students' majors—variables that can affect interpretation of primary data on academic progression and the benefits of undergraduate research.

Study Population and Methods

This study involved 34 undergraduates; 17 students in 2012 and 17 in 2013 participated in the summer undergraduate research program (URP) at TSU. These students entered as freshmen at TSU between fall 2008 and fall 2012. In the spring semester before participating in UR, six students were freshmen, nine were sophomores, 14 were juniors, and five were seniors. The study's 20 student participants from the College of Science and Technology (COST) were undergraduates majoring in science, technology, engineering, or mathematics (STEM) fields, which included engineering, transportation, aviation science, mathematics, computer science, biology, chemistry, and physics. The 14 students in colleges and departments other than COST included majors in sociology, social work, psychology, health science, education, English, political science, administration of justice, and fine arts. Students' data came from their application materials and from TSU's Office of Institutional Effectiveness.

Recruitment information about the 10-week summer program was communicated through flyers posted throughout the campus and an email announcement to all faculty members. The program was open to all undergraduates at TSU regardless of major. Most of the students chose their own research mentor, although some were aided in finding a mentor by the Office of Research. All mentors were full time faculty of at least the assistant professor rank, and they were required to have sufficient resources to carry out the students' projects. All students were required to submit an application containing personal and academic information, a personal statement, three letters of recommendation, a certified copy of their transcripts, and a short description of the proposed research. The Office of Research determined the appropriateness of the mentors and research projects. Sufficient funds were available so that all students who completed the application process, regardless of GPA, were accepted into the program. A stipend of $2,000 was provided for full-time participation (30 or more hours per week). The program

consisted of an orientation program lasting a full day, a progress report submitted after four weeks, a closing poster presentation by all students, and oral presentations by selected students. In the orientation meeting, topics including research ethics, laboratory safety, and scientific methodology were covered. Students did not receive academic credit, nor did mentors receive support for salary or supplies.

The control groups came from the 2006 freshman COST cohort (n=268). The 2006 cohort, with a mean GPA of 2.17, had a 49-percent persistence rate after the first year, while the URP cohort had 100 percent persistence, with a mean GPA of 3.20. To accommodate the wide differences in GPA and persistence between the undergraduate researchers and the 2006 cohort, two different control groups were constructed based on GPA or persistence: Group I (n=128, GPA 3.12) was based on students having a minimum GPA of 2.5 or greater for fall 2006; Control Group II (n=65, GPA 3.22) consisted of the subset of 128 students in Control Group I who were continuously registered at TSU from fall 2006 through fall 2008.

Progression rates were from fall to fall and were measured from the fall freshman year for one year (sophomore progression) or two years (junior progression). For analysis of graduation rates of research students, the 2011 and 2012 entering freshmen (n=12) were excluded because they were at TSU for fewer than four years. Analyses of six-year graduation rates assumed that the students who no longer were registered at TSU did not transfer and graduate from another college or university.

Graduation data through December 2014 was used. GPA data were analyzed by students' t-tests. All other statistical analyses between URP students and control subjects were done by chi-square analyses using a two-tailed test. Statistical significance was set at $p < 0.05$.

Table 1: Demographics of the URP and Control Populations

Groups	URP Students	Control Group I	Control Group II
African-American	31/34 (91.2%)	115/128 (89.8%)	58/65 (89.2%)
Female Students	23/34 (67.6%)	66/128 (51.6%)	37/65 (62.2%)
STEM Majors-for those who graduated only	10/17 (58.8%)	24/34 (70.6%)	24/34 (70.6%)

Statistics: chi-square analyses; race, gender or STEM major-URP versus control groups—no significant differences.

Results

Table 1 shows the demographic data for URP students and those in Control Groups I and II. Approximately 90 percent of students in each group were African-American. More than 50 percent of each group was female, and the groups were not significantly different from each other statistically. Also, the percentage of students in each group who graduated with STEM majors was not significantly different from each other statistically.

Table 2 shows that there was no significant difference in the GPAs of URP students between their fall freshman semester and their final cumulative GPAs. However, in Control Group I there was a highly significant decrease in student GPAs between their fall freshman semester and their final cumulative GPAs ($p < 0.0001$). Similarly, in Control Group II there was a highly significant decrease in student GPAs between their fall freshman semester and their final cumulative GPAs ($p < 0.0001$). As the fall freshman GPAs for all groups were not different (Table 2), the groups mainly differed in that the URP students did mentored research between their fall freshman semester and December 2014, if they had not graduated in 2014.

Table 2: Mean GPA in the Freshman Fall Semester Compared to Mean Cumulative GPA

Groups	Fall GPA Freshmen (SEM)*	Cumulative GPA (SEM)	*T*-Test Paired *t* (p-value)
URP Cohort N=34	3.20 +/- 0.12	3.18 +/- 0.09	0.17 (NS)
Control Group I N=128	3.12 +/- 0.03	2.61+/- 0.06	10.20 (< 0.0001)
Control Group II N=65	3.22 +/- 0.05	2.76 +/- 0.06	7.50 (< 0.0001)
URP / Group I *T*-Test Unpaired *t* (p-value)	0.84 (NS)	4.8 (< 0.0001)	-
URP / Group II *T*-Test Unpaired *t* (p-value)	0.18 (NS)	3.8 (< 0.0003)	-

*Standard Error of the Mean

Table 3 shows progression rates for URP students compared to control groups. The progression rates from the freshman to the sophomore year for URP students were significantly higher compared to those for students in Control Group I ($p < 0.0001$) and Control Group II ($p < 0.0001$). Similarly,

Table 3: Progression Rates of URP Students and Control Populations

Groups	Number	Progression to Sophomore	Progression to Junior
URP Cohort	34	28 (82.4%)	22 (64.7%)
Control Group I	128	29 (22.7%)	15 (11.7%)
Control Group II	65	25 (38.5%)	14 (21.5%)

URP versus control group I (Sophomore Progression); $x^2 = 42.0$, $p < 0.0001$.
URP versus control group I (Junior Progression); $x^2 = 42.8$, $p < 0.0001$.
URP versus control group II (Sophomore Progression); $x^2 = 17.3$, $p < 0.0001$.
URP versus control group II (Junior Progression); $x^2 = 18.0$, $p < 0.0001$

the progression rates from the sophomore to the junior year for URP students were significantly higher compared to students in Control Group I ($p < 0.0001$) and Control Group II ($p < 0.0001$).

Table 4 shows the six-year graduation rates of URP students compared to those of students in the two control groups. The six-year graduation rates were significantly higher for the URP students compared to students in Control Group I ($p < 0.0001$) and Control Group II ($p < 0.0060$).

Table 4: Fall Freshman GPA and Six-year Graduation Rates of URP Students and Control Populations

Groups	Number	GPA	6 yr graduation	Statistics* x^2 (p-value)
URP (2008-2010 Freshmen)	22	3.09	17 (77.3%)	-
Control Group I	128	3.12	28 (21.9%)	27.4 (< 0.0001)
Control Group II	65	3.22	28 (43.10%)	7.7 (< 0.0060)

*Statistics: URP versus control group.

Discussion

As noted above, TSU is an HBCU with its own summer undergraduate research program for TSU students (Owerbach, Ohia and Oyekan 2013). Most studies of African-Americans doing undergraduate research are at sites external to HBCUs (NSF-REU and HHMI programs) that apply rigorous selection standards (Beninson et al. 2011). By contrast, all TSU undergraduate students who applied by the deadlines were accepted into the URP.

Institutional data revealed that the 2006 student cohort (n=268) from the College of Science and Technology had a mean GPA of 2.17 and that only 49 percent of these students persisted for more than one year. For a valid and meaningful study, it was essential to have a control group or groups matched as closely as possible to the URP group. Our Control Group I (n=128) consisted of students with GPAs of 2.5 or greater in their fall freshman year—a criterion that led to the exclusion of 140 students from the initial COST cohort (n=268). Control Group II was even more selective and was based on the subset of students in Control Group I (65 of 128) who remained registered at TSU from fall 2006 through fall 2008. The URP and both control groups had similar mean GPAs as freshmen during their initial fall semester (Table 2), thus eliminating initial GPA as a bias.

A critical observation is that the URP students maintained their GPAs, while the students in both control groups earned significantly poorer grades after their initial fall semester (Table 2, URP versus Control Group I, $p < 0.0001$; Control Group II, $p < 0.0001$). To our knowledge, few studies have reported the effect of undergraduate research on GPA when both the students exposed to research experience and the control populations had similar initial GPAs. In one study that is most comparable to ours, Kinkel and Henke (2006) showed that GPAs significantly increased for students exposed to research, from 2.59 to 3.03 at graduation. In their control group, the student GPAs were unchanged (2.59 before exposure to research and 2.63 at graduation). Our study differs from Kinkel and Henke (2006) in that starting GPAs for both our URP students (3.20) and control subjects (3.12) were much higher than the mean GPA of 2.59 in their study. Furthermore, the racial composition of the two studies was different as their study included only one African-American. However, both studies are similar in that students exposed to research had higher GPAs relative to control populations.

In evaluating how GPA affects progression and graduation rates, we compared these metrics between URP students and the control populations. The significantly higher sophomore and junior progression rates and six-year graduation rates compared to students in Control Groups I and II (Table 3 and 4) are striking. This is underscored by the fact that Control Group II (n=65) consists of fewer than 25 percent of the initial COST student cohort (n=268), as most of the COST cohort had very poor fall freshman GPAs (137 students with GPAs of less than 2.5) and/or extremely low retention rates (136 students did not persist beyond the first year). Clearly,

the students in Control Group II had a sufficiently high GPA in the fall semester to indicate sufficient academic skills for student success at TSU. Furthermore, the fact that these students all remained registered at TSU from fall 2006 through fall 2008 indicates their motivation for academic persistence.

Since both Control Groups I and II had initial GPAs similar to the URP population in the freshman fall semester, additional factors were examined to determine if they affected our findings of differences in GPAs and rates of progression and graduation. The widely recognized academic under-performance of minorities led us to examine race as a variable. Both control groups and the URP students were approximately 90 percent African-American, thus eliminating this variable as a major contributory factor. Because 100 percent of our control populations entered TSU as STEM majors and because our URP participants at the time of the program majored in both STEM (59 percent) and non-STEM majors (41 percent), we examined the majors of the students from our URP (n=17) and control groups (n=34 each) at the time of graduation. The percentage of STEM majors between groups was similar and indicates that students' majors were not a significant factor (Table 1). Gender was also considered as a variable in our study. The percentage of female students in URP (67.6 percent) and Control Group II (62.2 percent) was similar and thereby eliminates this variable as a contributory factor.

Our study has two major limitations. The first is the relatively small size of the URP population (n=34) , and the second has to do with the degree of similarity between the experimental and control populations. Although the URP and control groups had similar starting GPAs, ethnicity, gender, and majors, other variables were not studied. Specifically, the URP population was selected on the basis of those volunteering to participate in a summer research program, and the control populations were those without mentored research exposure. In other words, what motivates some students to participate in summer research and why do some students with high initial grades in their fall freshman semester have poor retention and graduation rates? Some variables to examine in future studies include students' financial status (student aid, family-support obligations, and time spent at outside jobs) and student academic factors (non-research faculty mentoring interactions and participation in campus organizations).

Overall, our results are consistent with other studies reporting improved progression and graduation rates for undergraduates participating in undergraduate research programs (Pascarella and Terenzini 1979; Jonides 1995; Nagda et al. 1998; Jones, Barlow and Villarejo 2010). The novelty of our study is the differential cumulative GPAs and progression and graduation rates between URP and control populations despite similarities in race, gender, STEM majors, and initial freshman fall GPAs. More studies are especially needed to examine the effect of undergraduate research on GPA improvement, as the literature in this area is scanty (Kinkel and Henke, 2006; Junge et al. 2010).

References

Beninson, Lida A., Jessica Koski, Erika Villa, Ronnie Faram, and Sally E. O'Conner. 2011. "Evaluation of the Research Experiences for Undergraduate (REU) Sites Program." *CUR Quarterly* 32(1): 43-48.

Crowe, Mary, and David Brakke. 2008. "Assessing the Impact of Undergraduate Research Experience on Students: An Overview of Current Literature." *CUR Quarterly* 28(4): 43-50.

Fakayode, Sayo O., Mamudu Yakubu, Olasumbo M. Adeyeye, David A. Pollard, and Abdul K. Mohammed. 2014. "Promoting Undergraduate STEM Education at a Historically Black College and University Through Research Experience." *Journal of Chemical Education* 91(5): 662-665.

Jones, Melanie T., Amy E. L. Barlow, and Merna Villarejo. 2010. "Importance of Undergraduate Research for Minority Persistence and Achievement in Biology." *The Journal of Higher Education* 81(1): 82-115.

Jonides, John. 1995. "Evaluation and Dissemination of an Undergraduate Program to Improve Retention of At-Risk Students." Michigan, Ann Arbor, MI: College of Literature, Science, and the Arts, University of Michigan.

Junge, Benjamin, Catherine Quinones, Jakub Kakeitek, Daniel Teodorescu, and Pat Marsteller. 2010. "Promoting Undergraduate Interest, Preparedness, and Professional Pursuit in the Sciences: An Outcomes Evaluation of SURE program at Emory University." *CBE - Life Sciences Education* 9(2): 119-132.

Kinkel, Doreen H., and Scott E. Henke. 2006. "Impact of Undergraduate Research on Academic Performance, Education Planning, and Career Development." *Journal of Natural Resources & Life Sciences Education* 35(1): 194-201.

Lopatto, David. 2004. "Survey of Undergraduate Research Experiences (SURE): First Findings." *Cell Biology Education* 3(4): 270-277.

Lopatto, David. 2007. "Undergraduate Research Experiences Support Science Career Decisions and Active Learning." *CBE - Life Sciences Education* 6(4): 297-306.

Lopatto, David. 2010. "Undergraduate Research as a High-Impact Student Experience." *Peer Review- Association of American Colleges and Universities* 12(2): 27-30.

Nagda, Biren A., Sandy R. Gregerman, John Jonides, William von Hippel, and Jennifer S. Lerner. 1998. "Undergraduate Student-Faculty Research Partnerships Affect Student Retention." *The Review of Higher Education* 22(1): 55-72.

Nnadozie, Emmanuel, John Ishiyama, and Jane Chon. 2001. "Undergraduate Research Internships and Graduate School Success." *Journal of College Student Development* 42(2): 145-156.

Owerbach, David, Sunny E. Ohia, and Adebayo Oyekan. 2013. "Outcomes of Texas Southern University's Summer Undergraduate Research Program." *CUR Quarterly* 34(2): 43-46.

Pascarella, Ernest, and Patrick T. Terenzini. 1979. "Student-faculty Informal Contact and College Persistence: A Further Investigation." *The Journal of Educational Research* 72(4): 214-218.

Taraban, Roman and Erin Logue. 2012. "Academic Factors that Affect Undergraduate Research Experiences." *Journal of Educational Psychology* 104(2): 499-514.

David Owerbach
Texas Southern University, owerbachd@tsu.edu

David Owerbach is a proposal-development officer in the TSU Office of Research and program coordinator for the summer undergraduate research program. Before joining TSU, Owerbach was an associate professor of pediatrics at Baylor College of Medicine in Houston.

Adebayo Oyekan is professor of pharmacology in the College of Pharmacy and Health Sciences and is director of the Center for Cardiovascular Diseases at TSU. Oyekan has used resources from his National Institutes of Health grants to promote undergraduate research training at TSU since 2000, with many of the participants in the annual summer research internships subsequently entering graduate and professional programs around the nation.