

## **Experimental Evidence of Professor Engagement on Student Outcomes**

Scott E. Carrell  
Michal Kurlaender  
*University of California - Davis*

Monica P. Bhatt  
*University of Michigan*

### **Abstract**

To test the effect of professor feedback on student success in higher education classrooms, we conducted a small-scale randomized intervention in a large, introductory-level microeconomics course at a comprehensive research university. The “light-touch” intervention consisted of two strategically-timed e-mails to students from the professor indicating the professor’s knowledge of the students’ current standing in the course, keys to success in the class, and a reminder of when the professor is available. Results show that students in the treatment group scored higher on exams, homework assignments, and final course grade, compared to students in the control group. In addition, the results indicate positive, though insignificant effects, on time spent on homework assignments and a lower likelihood of dropout/failure.

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### *Introduction*

To date, much of the research on college success has been focused on barriers to entry and on individual student determinants. Perhaps due to this robust body of research and policy focus, a more diverse group of students is able to take advantage of the opportunities provided by postsecondary institutions in the U.S. However, a consequence of this increased access is an acknowledgement that institutions must learn more about better supporting students' pathways to academic success and degree completion. One potential lever for increased student success and degree completion is professor engagement. In this paper we provide compelling evidence from an experimental study of a light touch intervention of professor engagement. We frame the work within the broader empirical and theoretical discussion of the determinants of student postsecondary success, particularly degree completion.

### *Research Context*

The rising value of a college degree has been well documented among social scientists (Pew Research Center, 2014; Baum, Ma, & Payea, 2013), and more recently, in the popular press (Leonhardt, New York Times, 2014). The benefits of a college degree for individuals and for society include higher earnings, and, as a result, tax contributions, health outcomes, and a variety of social outcomes (Baum et al., 2013). Despite increases in college attendance, however, college completion has not kept up (Turner, 2004; Pew Research Center, 2014). Moreover, many disparities by social origin and race/ethnicity exist in college access, type of college enrollment (two-year versus four-year enrollment), college selectivity, and college completion. While a substantial body of empirical work—including a growing number of randomized control trials—

exists on improving college access, particularly for low income and other underrepresented groups (Castelman, Page, & Schooley, 2014; Carrell & Sacerdote, 2013; Hoxby & Turner, 2013; Bettinger, Long, Oreopoulos, & Sanbonmatsu, 2012; Avery & Kane, 2004; Oreopoulos, Brown & Laveccia, 2013), the research base is decidedly thin on how to keep students in college and on improving degree completion. This lack of evidence is a problem that must be addressed given low degree completion rates not only at community colleges, but also at many of the nation's broad-access, B.A.-granting, four-year institutions (Snyder & Dillow, 2013).

### *Determinants of College Persistence and Completion*

Low graduation rates may be, in part, because of the rising complexity of higher education enrollment. Today's college students are substantially different than those from several decades ago: They are more likely to be going to college part-time, to be working while in college, to have attended multiple institutions on the road to the B.A., and to be the first in their families to attend college (Horn, Peter, Rooney, & Malizio, 2002). Students who enter college fail to complete a degree for many reasons. At the individual level, this may include lack of preparation, financial constraints, and/or simply a loss of interest in college.

Institutional policies and practices may also play an important role in predicting degree receipt. Colleges vary widely in the share of entering freshman they graduate within four, five or six years. While the average four-year completion rate at four-year degree-granting institutions is a modest 36.8%, many schools graduate fewer than 25% of their students in four years, while others graduate nearly all of their students in four years (Knapp, Kelly-Reid, & Ginder, 2012). College selectivity accounts for an appreciable share of the institutional variation in college graduation overall (Melguizo, 2008; Small & Winship, 2007), though work focusing specifically

on community colleges has found less consistent evidence on the role of institutional quality measures on students' outcomes (Calcagno, Bailey, Jenkins, Kienzl, & Leinbach, 2008; Sandy, Gonzalez, & Hilmer, 2006; Smith & Stange, 2013; Stange, 2012; Kurlaender, Carrell, & Jackson, 2015). Reports by the American Association of State Colleges and Universities (2005) and The Education Trust (Carey, 2005; Yeado, Haycock, Johnstone, & Chaplot, 2014) speculate about why some public four-year colleges and universities are more successful than others at retaining students. Although reports suggest that campus leadership on issues of retention may influence graduation outcomes, even when holding constant the typical set of institutional characteristics (e.g., size, sector, prestige, and average SAT/ACT scores), they do not provide direct evidence of how specific institutional policies affect college completion. Several papers have also suggested that cohort crowding and declining resources (particularly at less selective public institutions) may also lead to reductions in rates of college completion and increases in time to degree (Bound, Lovenheim, & Turner, 2010, 2012).

### *Interventions to Improve College Retention and Completion*

What practices or programs lead to higher retention and degree receipt? Prior research and theory suggests that student interaction with faculty and peers, sense of community, active engagement with the institution, and mentoring may contribute to higher rates of persistence (Astin, 1993; Habley, Bloom, & Robbins, 2012; Lotkowski, Robbins, & Noeth, 2004; Braxton, 2000; Tinto, 1993). More recent correlational analyses of student surveys reveal that students had more positive perceptions of their experiences in campuses where faculty also perceived higher levels of engagement with students (Umbach & Wawrzynski, 2005). Although these provide promising directions for higher education institutions, many of these studies fail to

adequately control for observable and unobservable differences between students who select different kinds of colleges or collegiate experiences. Consequently, these studies likely conflate the contributions of student characteristics to institutional rates of postsecondary persistence with those of institutional practices.

Several experimental and quasi-experimental studies explore specific faculty characteristics and institutional practices and programs, and their impact on persistence and degree attainment. Lindo, Sanders, and Oreopoulos (2010) investigate the effects of academic probation on academic achievement and persistence and find that being placed on probation at the end of the first year discourages some students from returning to school while improving the GPAs of those who do (Lindo, Sanders, & Oreopoulos, 2010). Another potential setback is course scarcity, yet some research finds that students who experience more course shutouts do not necessarily take longer to graduate (Kurlaender, Jackson, Howell, & Grodsky, 2014). Studies exploring faculty characteristics have also shown that faculty gender, race/ethnicity, rank, education and experience can significantly influence student outcomes such as course performance, choice of major and graduation (Carrell & West, 2010; Carrell, Page, & West, 2010; Fairlie, Hoffman, & Oreopoulos, 2013; Hoffman & Oreopoulos, 2009). However, it is unclear exactly why professor characteristics are correlated with student achievement. Finally, it is also not clear that cash incentives lead to improved retention or academic success (Angrist, Lang, & Oreopoulos, 2009; Angrist, Oreopoulos, & Williams, 2014).

There have been several interventions that have focused on increasing student supports in college retention and completion efforts. One of the largest studies in this area is on learning communities (a practice that groups students together in several courses, often with additional supports). A rigorous evaluation of learning communities conducted by MDRC found generally

positive effects of this approach on long-term outcomes such as graduation, and modest short-term outcomes (Sommo, Mayer, Rudd, & Cullinan, 2012). However, they also report several challenges associated with this strategy (Visher, Weiss, Weissman, Rudd, & Wathington, 2012). More recently, the City University of New York's (CUNY's) Accelerated Study in Associate Program (ASAP) saw huge improvements in students' academic outcomes, nearly doubling graduation rates for low-income students needing developmental education at community colleges (Scrivener et al. 2015).<sup>1</sup> Others have tested less intense interventions focused on increasing student support. For example, Bettinger and Baker (2014) find that a relatively light touch individualized student coaching intervention led to higher retention and completion rates. Treated students received a coach that provided individualized advising to students at several points in the year about goal-setting, time management, and study skills in college (among other things). Results from the intervention on college retention reveal a treatment effect of nine percent at six months and twelve percent at one year. Notably, they also find lasting effects of the treatment; positive effects on retention persisted—albeit were somewhat attenuated—up to two years after the coaching had been in effect.

#### *A “Light-touch” Intervention for Professor Engagement*

Building on this literature, we designed and implemented an intervention to provide personalized information and encouragement to students enrolled in a large introductory course at a comprehensive university. The intervention itself consists of personalized emails from the professor to students at the beginning and middle of the term, providing them with both specific

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<sup>1</sup> ASAP is an intensive intervention, providing a host of services to students, including advising, tutoring, linked courses, tuition waivers, and even Metro cards for public transportation.

information about the necessary steps to succeed in the course and encouragement about how to be successful in college more generally.

### Intervention

Students in the treatment condition received two e-mails with the explicit purpose of providing information about (1) how they are progressing in the class; (2) how to be successful in the class; and (3) the availability of the professor and other supports. Specifically, we tested whether these personalized messages from faculty influenced short-term outcomes such as homework and midterm exam performance, and medium-run outcomes, such as course completion and final performance. We also test potential mechanisms for the interpretation of results by surveying students on their perception of the professor and the course after the submission of the final exam.

The intervention is “light touch” in that it requires a modest amount of extra time on the part of the faculty member to implement. The specific treatment is built upon theories from behavioral economics about information, from education on the role of feedback and student outcomes, and from social psychology on self-efficacy and affirmation. Moreover, the intervention rests upon one key premise: Faculty are an important and (potentially) under-utilized resource to increase student success more generally and retention and completion more specifically. Our hypothesis is that receiving additional information about course performance and positive directions and encouragement regarding college success can improve students’ sense of self-efficacy and influence their decision to persist towards, and ultimately complete, the degree.



## Theoretical Framing

At the heart of our treatment is the notion that increased information provided by faculty to students regarding their performance and direction and encouragement for future success. We know from human capital theory that the individual decision to invest in education (i.e. persist in college) should be based on an interaction of students' resources (financial or otherwise) to enroll, tastes for the college experience, and ability to do the work. Students rely on many sources of information to make these decisions, and rational choice theory assumes that individuals will use all available information to make the best decisions in order to reap the greatest benefit. That is, students will use information about the cost of college, their experience in college (grades, friends, etc.), and, arguably, some knowledge about the long-term benefit of having a college degree to make the optimal decision about whether to stay in school (Avery & Kane, 2004).<sup>2</sup> However, recent work in behavioral economics is more critical of rational choice, and posits that human behavior is more psychologically driven. Hence, decisions are heavily influenced by factors such as how the information is conveyed, by whom, and in what context (Thaler & Sunstein, 2008). Here, we hypothesize that a small increase in information from faculty while students are enrolled in a course can influence performance in that course, and ultimately, their persistence in college. We note that this increase in information is above and beyond normal information sources available to students such as performance on course exams or overall course grades.

We also conceive of the information being provided to students as a form of personalized feedback, given that it happens after faculty have some indication of student performance in the

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<sup>2</sup> Students may display hyperbolic discounting (Laibson, 1997) in evaluating the costs and benefits of staying in college. That is, short sightedness causes them to highly discount the benefits of increased earnings, which are likely years away.

course, and then tailor the information in light of their performance. Feedback in the teaching and learning literature refers to the information provided in response to one's performance or understanding. As such, feedback is considered a "consequence of performance" (Hattie & Timperley, 2007). Empirical evidence from the literature on feedback suggests that it can be a powerful influence on achievement in the K-12 context, but that it is also highly variable. A meta-analysis found that studies showing the highest effect sizes involved students receiving feedback about a task and how to do it more effectively, while lower effect sizes were associated with feedback in the form of praise, rewards, and punishment (Hattie & Timperley, 2007; Kluger & DeNisi, 1998). Our intervention is not focused on changing how faculty grade assignments or provide feedback on specific course tasks, rather on how they can provide feedback about the processes underlying the tasks expected of students in their courses and the strategies students can incorporate to improve performance. Feedback at this "process level" has been found to be particularly effective (Balzer, Doherty, & O'Connor, 1989) and is the basis for the information faculty in our intervention will be providing. Specifically, we provide feedback on how to seek help (a learned process) and how to overcome potential self-doubt or embarrassment about such help-seeking behavior (Karabenick & Knapp, 1991). In fact, a critical mediator to feedback is the perception of self-efficacy (Hattie and Timperley, 2007; Kluger & DeNisi, 1998). That is, feedback is particularly valuable if it also encourages and promotes students' sense of self-efficacy.

Although largely framed as an information and feedback intervention, our underlying theory of change suggests that this information can have important consequences for students' sense of self-efficacy and help-seeking behavior. The belief that people can achieve what they desire through their actions is the foundation of self-efficacy theory (Bandura, 1993). Self-

efficacy is a key component to how students may handle challenging or unpredictable situations and, importantly, how much effort they may decide to expend or how long they persist in light of challenging or unpredictable situations. Individuals' perceived sense of efficacy can influence actions indirectly, for example, by its impact on goals and aspirations, their effort and commitments to different pursuits, and how they cope with stressful situations (Bandura & Schunk, 1981). Feedback can play an important role in perceived self-efficacy. Experiments from social psychology demonstrate that accentuating positive growth rather than shortfalls enhance self-efficacy, aspirations, and performance (Bandura, 1993).

### *Study Design*

The study setting was a large, introductory-level microeconomics course with an initial enrollment of 420 students at a large selective comprehensive university. In this course, students are required to complete 5 of 7 homework assignments throughout the term. However, data from prior years of this course indicate that failure to complete the first homework is a good early indication of struggling students. That is, historically, students who do not complete (or fail) the first homework assignment tend to perform significantly worse, on average, compared to their peers.

During the spring quarter of 2014, the research team randomized students who did not submit or failed the first homework assignment into a treatment and control group. Random assignment of study subjects to treatment and control eliminates alternative explanations in the form of selection bias or omitted variable bias because each group is equal in expectation for receiving the treatment. Therefore, the estimates produced by this design can be interpreted as causal.

Students in the treatment group received a two-tiered intervention in the form of e-mails from

the professor reminding them of the behaviors that lead to success in the course (attend class, complete practice problems, attend section and utilize office hours as needed) and a reminder of when the professor is available.

The first e-mail to the treatment group was sent as a result of failing the first homework assignment. The second e-mail to the treatment group was sent after the first midterm exam and feedback to students was based on their exam performance:

- **Group A:** Students that received a B+ or higher; the e-mail text applauds the student on a job well-done and reminds the student of the professor's availability.
- **Group B:** Students that received between a C- and B; the e-mail text tells the student what their grade in the course is likely to be based on this midterm performance and highlights that it is not too late and the set of behaviors that will help the student be successful in the course, as well as reminds the student of the professor's availability.
- **Group C:** Students that received lower than a C on the midterm; the e-mail text warns the student that based on his/her trajectory, the student may be at risk of failing the course, but reminds them there is time to recover and details the behaviors that would allow them to pass the course, and mentions the professor's availability.<sup>3</sup>

During the course of the term, we tracked students' course dropout status, homework completion, time spent on homework, midterm and final exam scores, final course grades, and office hour attendance. We also asked students at the end of the class about their personal motivation to do well in the course and their perception of how much the professor cared about their performance.

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<sup>3</sup> A fourth group of five students who had dropped out of the course from the treatment group at the time the second e-mail was sent received no e-mails.

Data were collected through the MyEconLab portal through which students submitted assignments, office-hour sign-in sheets, course gradebooks, and two survey questions placed on the final exam. In addition, we merged student-level data from the University registrar on student sex, underrepresented minority status, whether or not a student was a first-generation college student, high school GPA, residency status, and the year in which they entered college.

### Analytic Sample

The analytic sample was chosen from an entering-level economics course consisting of 420 students. Students who did not submit the first homework assignment (N=69) were randomly assigned to a treatment (N=35) and control group (N=34). Table 1 shows that the sample of students is 68% male, 89% California residents, 26% of students are first-generation college students, 23% of students are underrepresented minorities, 23% of students in the study sample dropped out of the course. Table 2 shows that the treatment and control groups are comparable with respect to student characteristics with some minor differences. For example, the treatment group has more first-generation college students than the control group (28% as compared to 25%), but the control group has a greater proportion of underrepresented minority students (29%) than the control group (17%). We conduct randomization checks on the comparability of treatment and control group by regressing student characteristics on an indicator variable for treatment status (Table A1). The results indicate that student characteristics are not predictive of treatment status. This evidence supports that argument that randomization created groups that were equal in expectation for receipt of the treatment.

[Insert Tables 1 &2 about here]

## Analytic Strategy

The study design, random assignment of study subjects to treatment or control status, allowed for a simple analytic strategy. Specifically, we use ordinary least squares (OLS) regression analysis to calculate the average treatment effect for our “light-touch” intervention with the following regression:

$$Y_i = \alpha + \beta * \text{treat}_i + \gamma * X_i + \epsilon_i$$

Where Y represents our respective outcomes of interest, "treat" is a dummy variable for treatment versus control status and X is a vector of individual student characteristics. In this analysis,  $\beta$  represents the average causal effect of the (intervention) on student outcomes. We investigate several outcomes: exam grades, total course score and grade, homework score, time spent on homework, office hour attendance, attitudinal measures towards the course and professor, and course completion.<sup>4</sup>

We calculate a treatment effect for each outcome variable of interest using three specifications. The first specification includes only a dummy indicator for treatment status. The second specification includes TA fixed effects to account for variation in teaching and learning across each of the four TAs in the course. Each student in the course was assigned to one TA and attended his/her small-group section once a week. Attendance at section was not mandatory, nor was seeking out TA assistance in office hours was not. The TA fixed effects are represented by a dummy indicator for each TA and allows comparisons between individuals with the same TA while eliminating between-TA differences. The third and final specification includes both TA fixed effects and student-level controls. Individual control variables include whether the

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<sup>4</sup> For analyzing treatment effects on survey questions “The professor cares about my performance” and “I am motivated to do well in the course” we use a probit model that accounts for a binomial outcome.

student is male, first-generation college student status, under-represented minority status, California residency status, entering cohort year, and high school GPA. In addition, we conducted a randomization check by regressing individual student characteristics on treatment status both with and without TA fixed effects. Results showed that there are no statistically significant relationships between individual characteristics and treatment status.

### *Results*

Results are displayed in Table 3 for each outcome variable of interest over three specifications: (1) no controls, (2) TA fixed effects, and (3) TA fixed effects and student demographic controls. Results are presented for students in the sample who did not dropout of the course. Results presented in Panel A of Table 3 indicate a strong positive treatment effect of 14 percentage points on students' second midterm scores, which followed after the second e-mail of the intervention. Perhaps driven by this treatment effect on the second midterm, students in the treatment group also performed 8 percentage points (or approximately half a letter grade) higher compared to their control group peers on their final course grade. Students in the treatment group also scored approximately 15 percentage points higher than students in the control group on their overall homework assignments.

Results in Panel B of Table 3 indicate that there is some evidence that students in the treatment group spent as much as two hours more total time on their homework assignments, as measured by time spent in the MyEconLab portal; however, these results are not statistically significant. Similarly, the results suggest that there are small, positive treatment effects on the number of office hour visits and negative effects on the likelihood of dropping out of the course. However, these results are also not statistically significant. Finally, there is some evidence

(Panel C) that students in the treatment group are more likely to report that their professor cares about their performance but less likely to report that they are motivated to do well in the course. Again, these results are not statistically significantly different from zero.

[Insert Table 3 about here]

These results suggest that a light-touch intervention that demonstrates professor engagement can significantly affect students' course performance. Potential mechanisms for this treatment effects may be that students spend more time on assignments and devote more time on course material. Alternatively, students may feel more comfortable seeking help from the professor or TA and therefore understand the material better. A third reason may be that students feel the professor cares about their experiences, causing them to be more motivated and engaged.

Although this study does not provide quantitative support for these plausible explanations, (due in part to the small sample size), we do, however, have qualitative feedback that may indicate that the third explanation, that students value the professor's engagement and concern for their well-being, was an important feature of the course for students in the treatment group. Several students from the treatment group wrote e-mails expressing their gratitude towards this individual attention. Examples of this feedback include:

- *I'd...like to thank you for offering your help in such a kind manner, I've rarely seen teachers at this school respond to missed assignments the way you have. I'll be sure to complete future assignments in a timely manner, the first practice homework was indeed pretty helpful.*
- *Thanks for talking to me about my homework and test scores. Even though you have a couple hundred students, I really appreciate the effort you put into making it personal*



*for your students. I would have gone to office hours the first time you emailed me, but I simply forgot by the end of the week.*

- *This class is fulfilling a GE for me and my other classes do rank higher on my list. While I do enjoy microeconomics and usually aim to only take GE's that interest me, I'm just too busy to spend too much time on the homework. I definitely plan to study and practice extensively for the tests, but not make it a priority, which I know is not ideal but a reality for this quarter. But once again, thanks for the email, I really appreciate what you're doing and I do wish more professors do what you are doing.*

It is worth noting that each of these comments suggest that students are appreciative primarily of the contact between them and the professor, rather than the information provided itself. These e-mails indicate that students are not accustomed to receiving individualized attention from their professors in large, introductory courses and that they are appreciative of such gestures.

Unfortunately, given the small-scale nature of the study, we were not able to fully interrogate the mechanisms by which the treatment effects were found.

### *Discussion & Conclusion*

The results of this study provide experimental evidence that professor feedback to students at early stages in their course-taking in college has significant effects on course performance. We also have limited evidence from student feedback that students recognize and appreciate this targeted approach on behalf of the professor in a positive light. These contributions are important as they provide avenues for further research along this often overlooked but important dimension of student retention in higher education.

By conveying beliefs in students' abilities to succeed in the course and in college more generally, college instructors have an important way to directly and indirectly contribute to college success: directly through the intended transfer of content knowledge and/or skills and indirectly through boosting students' sense of self-efficacy. Students' beliefs about college and how they process early difficulties can influence their postsecondary trajectory. These notions are not unrelated to the now popularized self-affirmation theory, which suggests that people are inherently motivated to see themselves as competent and in control of their future. When this is threatened, people work to restore their self-worth (Yeager & Walton 2011; Steele 1988; Sherman & Cohen 2006). There are a variety of interventions testing self-affirmation theory in the field, including one described in Paul Tough's *New York Times* magazine article, Who Gets to Graduate (May 15, 2014). Although our intervention does not include activities that directly test self-affirmation theory, we nevertheless know that validation at a challenging transition could improve an individual's trajectory (Cohen et al. 2009). Thus, we hypothesize that feedback and encouragement earlier in an academic transition, particularly from a faculty member, could trigger a host of positive effects (e.g. improved self-efficacy), or avert a downward cycle of self-doubt that may lead to premature departure from college.

As this is a small-scale study with a small sample size, we were unable to more fully identify the mechanisms by which such large positive effects occur, or to test different methods of delivery of the intervention (e.g., texting or written feedback). As a result, we can only speculate from the direct student feedback that the identification and contact with students was perhaps more important than the content of the e-mails per se; however, we cannot confirm this hypothesis. In addition, we were unable to explore heterogeneity of effects by different types of students (e.g., freshman vs. seniors, or first-generation students vs. peers with college-educated

parents), differences which are likely to exist, given the psychological nature of the intervention and the importance of such factors in higher education retention and success. Future studies may also want to explore whether there is variation in effect size by university or course type. Still, from the large and robust effects presented using a rigorous empirical strategy, we can be certain that professors can play an important role in the retention and success of students in large, introductory courses, and that early interventions that target students should be continued to be developed and studied.

This intervention provided students with, at minimum, a “nudge”<sup>5</sup> from faculty in two critical areas: recognition of their performance in the class and encouragement and direction for further success. Our hypothesis is that having direct feedback from faculty that is both individualized in knowledge of the student’s progress in the course and encouraging about their potential success could be a powerful motivator. Faculty are often an untapped source of (dis)encouragement and/or support for college students aspiring to obtain a degree. Despite considerable conjecture about the role of faculty, we have very limited evidence about their potential influence; this study suggests they can play a critical role in improving student success, even in a “light touch” way.

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<sup>5</sup> Recent experiments in behavioral economics also suggest that individuals can benefit from a “nudge” to complete tasks (Thaler & Sunstein, 2009).

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## Tables

**Table 1. Descriptive Statistics**

Variable	No. Obs.	Mean	SD	Min.	Max.
<i>Outcomes</i>					
Midterm 1 (%)	53	0.74	0.17	0.33	1
Midterm 2 (%)	53	0.68	0.20	0	1
Final Exam (%)	53	0.64	0.15	0	0.95
All Exams (%)	53	0.68	0.14	0	0.93
Total Course Score (%)	53	0.72	0.13	0.21	0.94
Course Grade (0-4)	53	2.40	0.89	0	4
Homework Score (%)	53	0.93	0.20	0	1
Homework Points Earned (%)	53	0.55	0.21	0	0.88
Homework Total Time Spent (hours)	53	7.05	4.16	0	14.82
Homework Median Time Spent (hours)	53	0.85	0.59	0	2.38
Prof Cares About My Performance	51	2.39	0.87	0	3
Motivated to Do Well in Course	52	3.02	1.02	0	4
Total Office Hour Visits (number)	53	2.32	2.29	0	9
Dropped Out of Course (%)	69	0.23	0.43	0	1
<i>Controls</i>					
Male	53	0.68	0.47	0	1
First Generation College Goer	53	0.26	0.45	0	1
HS GPA	53	3.77	0.37	2.87	4.24
Under-represented Minority	53	0.23	0.42	0	1
State Resident	53	0.89	0.32	0	1
Entering Cohort	53	2012.43	0.69	2011	2013

**Table 2. Descriptive Statistics by Treatment and Control**

	Treatment Group			Control Group		
	No. Obs	Mean	SD	No. Obs.	Mean	SD
<i>Outcomes</i>						
Midterm 1 (%)	29	0.77	0.18	24	0.71	0.17
Midterm 2 (%)	29	0.73	0.17	24	0.61	0.23
Final Exam (%)	29	0.65	0.13	24	0.63	0.18
All Exams (%)	29	0.71	0.13	24	0.65	0.16
Total Course Score (%)	29	0.75	0.11	24	0.68	0.14
Course Grade (0-4)	29	2.59	0.90	24	2.16	0.83
Homework Score (%)	29	0.96	0.12	24	0.89	0.26
Homework Points Earned (%)	29	0.59	0.21	24	0.49	0.20
Homework Total Time Spent (hours)	29	7.87	4.22	24	6.06	3.94
Homework Median Time Spent (hours)	29	0.97	0.54	24	0.70	0.62
Prof Cares About My Performance	29	2.55	0.78	22	2.18	0.96
Motivated to Do Well in Course	29	2.90	1.05	23	3.17	0.98
Total Office Hour Visits (number)	29	2.76	2.46	24	1.79	2.00
Dropped Out of Course (%)	35	0.17	0.38	34	0.29	0.46
<i>Controls</i>						
Male	29	0.66	0.48	24	0.71	0.46
First Generation College Goer	29	0.28	0.45	24	0.25	0.44
HS GPA	29	3.82	0.35	24	3.72	0.40
Under-represented Minority	29	0.17	0.38	24	0.29	0.46
State Resident	29	0.90	0.31	24	0.88	0.34
Entering Cohort	29	2012.48	0.69	24	2012.38	0.71

**Table 3: Results**

Panel A. Test Score Outcomes on Exams						
	1	2	3	4	5	6
Outcome	Midterm 1 (pct)	Midterm 2 (pct)	Final Exam (pct)	All Exams (pct)	Total Course Score (pct)	Course Grade (0-4)
No Controls	0.065 (0.048)	0.121** (0.054)	0.022 (0.042)	0.063 (0.039)	0.064* (0.034)	0.431* (0.239)
TA Fixed Effects	0.073 (0.052)	0.150** (0.057)	0.042 (0.043)	0.082** (0.041)	0.078** (0.036)	0.521** (0.249)
Individual Controls and TA Fixed Effects	0.057 (0.053)	0.136** (0.060)	0.049 (0.042)	0.076* (0.041)	0.076** (0.037)	0.501* (0.254)
Observations	53	53	53	53	53	53

  

Panel B. Homework Scores and Time Spent				
	1	2	3	4
Outcome	Homework Score (pct)	Homework Points Earned (pct)	Homework Total Time Spent (hours)	Homework Median Time Spent (hours)
No Controls	0.103* (0.057)	0.067 (0.055)	1.804 (1.131)	0.271* (0.159)
TA Fixed Effects	0.119* (0.062)	0.052 (0.060)	1.794 (1.242)	0.257 (0.175)
Individual Controls and TA Fixed Effects	0.152** (0.062)	0.075 (0.061)	1.969 (1.333)	0.311 (0.186)
Observations	53	53	53	53

**Table 3. Results Continued**

Panel C. Mechanisms					
	1	2	3	5	6
Outcome	Professor Office Hour Visits (number)	"Professor Cares About My Performance"	"Motivated to Do Well in Course"	TA Office Hour Visits (number)	Dropped Out of Course
No Controls	0.131 (0.103)	0.54 (0.332)	-0.328 (0.310)	0.967 (0.128)	-0.123 (0.102)
TA Fixed Effects	0.101 (0.105)	0.540 (0.332)	-0.328 (0.310)	0.802 (0.672)	NA
Individual Controls and TA Fixed Effects	0.093 (0.104)	0.535 (0.387)	-0.237 (0.367)	NA	NA
Observations	53	51	52	53	69

Notes: \* Significant at the 0.10 level, \*\* Significant at the 0.05 level, \*\*\* Significant at the 0.01 level. Each cell represents the results from regressing the outcome listed on a treatment dummy variable. Specifications 2 & 3 in panel C are estimated using an ordered Probit model. All other specifications are estimated using OLS. Individual control variables include whether the student is male, first generation college, under-represented minority, CA resident, entering cohort, and high school GPA.

**Table A1. Randomization Checks**

Independent Variables	Treatment Status	Treatment Status
Male	-0.155 (0.173)	-0.091 (0.173)
First Generation College Goer	0.058 (0.166)	0.05 (0.169)
HS GPA	0.153 (0.210)	0.081 (0.214)
Under-represented Minority	-0.227 (0.196)	-0.296 (0.196)
CA Resident	0.2 (0.244)	0.139 (0.243)
Entering Cohort==2012	-0.091 (0.252)	-0.162 (0.249)
Entering Cohort==2012	0.083 (0.239)	-0.042 (0.240)
Observations	53	53
P-value: Joint Significance of all individual covariates	0.8905	0.8449
Includes TA Fixed Effects	No	Yes

Notes: \* Significant at the 0.10 level, \*\* Significant at the 0.05 level, \*\*\* Significant at the 0.01 level. Each specification represents results for a regression where the dependent variable is an indicator for treatment status.