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How the Implementation of Honors Sections Affects the Academic Performance of Non-Honors Students

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INTRODUCTION AND JUSTIFICATION

Research in honors education generally credits honors students with elevating the academic experience for all students at an institution (see Andrews; Clauss; Brimeyer et al.). Honors students are seen as having a positive peer effect: setting a standard for other students to follow as well as stimulating and challenging faculty, thereby raising the level of the classroom for all (Joseph W. Cohen, cited by Andrews 38). Thus, many assume that moving honors students into separate sections adversely affects the academic performance of non-honors students, an assumption we faced at our institution. In the context of a study done in a college of engineering, that perception is even stronger because peer-to-peer and group projects are such important pedagogical elements of the engineering undergraduate curriculum. We are unaware of any research on how honors sections of general education courses affect the academic performance of non-honors students taking those same courses, but our study indicates that the implementation of honors sections for selected core courses in the University of Iowa (UI) College of Engineering did not adversely affect non-honors engineering students taking those same core courses.

OUR STUDY

In the fall of 2015, the UI College of Engineering inaugurated honors sections of core engineering courses for two reasons. First, the undergraduate engineering population had become large enough for honors sections to be economically and logistically feasible. The college's enrollment had increased from about 1,200 students to more than 2,000 over six years. New sections of the core first- and second-year courses were necessary, thus providing an opportunity to add honors sections. The second motivating factor came from the UI Honors Program, which had recently changed the criteria for eligibility and graduation requirements, reducing the total number of honors students and making an increased proportion of first-year engineering majors eligible for honors. Although engineering students had previously made up a large fraction of honors-eligible students, they were not easily retained because of scheduling constraints and the absence of honors courses in the engineering curriculum. The honors program and the college of engineering were both interested in attracting more engineering students to the honors program and graduating more engineering students with the honors credential.

The honors engineering sections were created and approved by the Engineering Faculty Council (EFC) on a trial basis. The EFC manages four subcommittees, and one of those subcommittees, the Curriculum Committee, was charged with developing a set of guiding principles for honors sections (see Appendix A) as well as making recommendations to the EFC regarding continuation of the honors sections. Honors students were not required by either the engineering college or the honors program to enroll in honors sections, but the EFC found a widespread belief among engineering faculty that removing high-performing students would negatively affect the non-honors students. Specifically, they felt that the honors courses would reduce the effectiveness of peer mentoring in the classroom by removing students who were most likely to master the material quickly. Many faculty members expressed this concern since peer mentoring was particularly important in the first two years of the engineering curriculum. Consequently, before committing to honors engineering sections as a permanent part of the curriculum, the EFC and the Curriculum Committee required an assessment after the first fall offering before approving continuation in subsequent years, hence the impetus for our study.

Our study was designed to determine whether the academic outcomes of non-honors students prior to the first offering of honors engineering course sections differed from the academic outcomes of non-honors students after the implementation of the honors program. We did not have a priori information to suggest that one cohort would do better than the other, so we believed it was critical not to assume that the control or test cohort would have achieved better outcomes. The criteria used to evaluate classroom performance came in part from grades available through registration records rather than direct learning objectives from each course. Although the assessment of learning objectives is an ongoing activity of the various engineering programs, most of these assessments are implemented later in the curriculum in order to provide feedback to each of the engineering specialty programs. The assessment of learning objectives in the core courses was beyond the scope of this study. Instead, our study used three measures of its outcomes: grades earned in the core courses themselves; retention as engineering majors; and grades earned in engineering courses taken by students in the semester following the target core courses.

METHODS

To conduct the analysis, we compared the outcomes of two cohorts: students who took at least one of the core sophomore-level engineering courses in fall 2014 (control cohort n = 569) or in fall 2015 (test cohort n = 576). These required sophomore-level classes are Engineering Fundamentals I: Statics; Engineering Fundamentals II: Electrical Circuits; and Thermodynamics. Table 1 provides a description of these courses. We identified the two cohorts by querying the UI registrar database to identify the students in fall 2014 and fall 2015 who had completed at least one of the core courses. (Hereafter, the fall 2014 cohort will be called "control cohort" and the fall 2015 cohort will be called "test cohort.") We obtained students' demographic information as well as their UI grade point averages. The University of Iowa granted us approval to use institutional data for our research study and to publish the results externally. We selected five downstream courses to represent courses commonly taken the next semester. The choice of these courses varied by engineering major.

We formulated the analysis around three questions that represented the concerns of the engineering faculty:

1. Did non-honors students in the test cohort achieve different final grades in the three core courses, on average, than non-honors students in the control cohort?
2. Was there a difference in the engineering-major attrition rate for the non-honors students in the test cohort and the non-honors students in the control cohort?
3. Compared with students in the control cohort, did non-honors students in the test cohort achieve different course grades in five selected downstream engineering courses?

Our assessment did not control for the change in faculty teaching the course in 2014 and 2015. With one exception, all the courses were taught by a different instructor the second year. One of the non-honors sections of Circuits in 2014 was taught by the same professor responsible for the honors section in 2015. For the analysis of grades earned in the core courses and the subsequent courses (Analysis 1 and 3), we adopted the assumption of independence and did not try to adjust for the variation introduced by instructors; we only examined whether non-honors students achieved higher or lower course grades in fall 2015 as compared with the fall 2014 cohort. We assumed that instructors of the core courses were teaching the same content, assessing

Table 1. Core Courses

Course Name	Description
Engineering Fundamentals I: Statics	Vector algebra, forces, couples, moments, resultants of force couple systems; friction, equilibrium analysis of particles and finite bodies, centroids; applications
Engineering Fundamentals II: Circuits	Kirchhoff's laws and network theorems; analysis of DC circuits; first order transient response; sinusoidal steady-state analysis; elementary principles of circuit design; analysis of DC, AC, and transient circuits using a circuit simulator.
Engineering Fundamentals III: Thermodynamics	Basic elements of classical thermodynamics, including first and second laws, properties of pure materials, ideal gas law, reversibility and irreversibility, and Carnot cycle; control volume analysis of closed simple systems and open systems at steady state; engineering applications, including cycles; psychrometrics.

similar skills, and using similar grade assessments. The course grades were on a scale of 0 (F) to 4.33 (A+), and the difference between adjacent letter grades (B and B+, for example) was a third of a grade point.

We calculated descriptive statistics in order to understand the variables related to the performance of non-honors students. We used multiple linear regression to control for variables that could confound the effect of the "Cohort" variable, including gender and cumulative GPA. We used an alpha level of 0.01 for hypothesis tests because these data are observational, and we wanted to establish a more rigorous critical value because we could draw upon several hundred subjects for analysis and detect small differences that are statistically significant. Our statistical tests were two-tailed tests because we did not have a priori information about whether one cohort would achieve better outcomes than the other.

RESULTS

Analysis 1: Examination of Students' Course Grades in the Core Courses

For this analysis, we computed three different linear regression models, one for each of the core courses. The University of Iowa GPA and gender were introduced as control variables, so the main test was whether non-honors students in the test cohort achieved different final grades after an adjustment for gender and GPA. Each model had the following form:

$$\textit{Course Grade}$$

$$= \beta_0 + \beta_1(\textit{UI GPA at start of term}) + \beta_2(\textit{Gender}) + \beta_3(\textit{Test Cohort}) + \textit{Error}$$

$$H_0: \beta_3 = 0$$

$$H_A: \beta_3 \neq 0$$

On average, non-honors students in the test cohort of Thermodynamics achieved a course grade that was a third of a letter grade lower than students in the control cohort after controlling for GPA (Table 2). The trend was the reverse for Electrical Circuits, and for Statics the difference between cohorts was not statistically significant. Thus, we determined that this analysis had an overall neutral result for non-honors students in the test cohort.

Analysis 2: Retention

To examine whether a greater proportion of students in the test cohort left the engineering major for another major, we gathered information about students' primary major at the end of the academic year in which they took one of the fall core courses. All students were engineering majors at the time of taking the core courses, so we computed the proportion of students in each cohort who had left the engineering major for a non-engineering major by the end of the academic year (Table 3). This difference in proportions is marginally statistically significant at the alpha 0.10 level (X^2 (1) = 2.83, p = .0927), suggesting that it may not be a meaningful difference. Still, a greater proportion of non-honors students from the fall 2015 test cohort left the major, and this could be cause for concern if the trend were to continue.

Analysis 3: Performance in Key Downstream Engineering Courses

To examine the effect of the honors sections on courses taken in the following semester, we computed five different linear regression models, one for each of five downstream engineering courses that students typically took in the spring of their sophomore year. UI GPA and gender were introduced as control variables because (1) UI GPA tends to be the best predictor (in the institutional data) of students' future course grades and (2) gender is a

Table 2. Non-Honors Students Performance in Core Courses

	Fall 2014 Non-Honors			Fall 2015 Non-Honors			Beta of Semester Variable (2015 vs. 14)	*p* value
	N	Mean	Std. Dev.	N	Mean	Std. Dev.		
Statics Grade	185	2.67	0.97	188	2.45	0.96	-0.13	.1577
Electrical Circuits Grade	188	2.35	0.86	201	2.49	0.93	0.23	.0075
Thermodynamics Grade	166	2.76	0.98	156	2.49	0.99	-0.32	.0030

Table 3. Non-Honors Students' Major at End of Academic Year

	Engineering	Not Engineering
Control Cohort	337 (96.56%)	12 (3.44%)
Test Cohort	353 (93.88%)	23 (6.12%)

confounding variable because female engineering majors had higher GPAs than males, $t(1085) = 6.82$, $p < .0001$. Thus, the main test was whether non-honors students from the test cohort achieved different final grades after an adjustment for gender and GPA. Each model had the following form:

$$Course\ Grade$$
$$= \beta_0 + \beta_1(UI\ GPA\ at\ start\ of\ term) + \beta_2(Gender) + \beta_3(Test\ Cohort) + Error$$
$$H_0: \beta_3 = 0$$
$$H_A: \beta_3 \neq 0$$

For the most part, students from the fall 2015 test cohort achieved similar (if not higher) average grades in key downstream courses. Only one of these differences was statistically significant at the alpha 0.01 level after controlling for GPA and gender: non-honors students from the fall 2015 test cohort achieved higher grades, on average, in ENGR:2710 (see Table 4). In three of the other four courses, the average final grade for the fall 2015 test cohort was higher than that of the fall 2014 cohort, but the differences were not significant at the alpha .01 level.

To summarize our results, in two of the three core courses we found, after we controlled for confounding factors, that non-honors students in the test cohort achieved lower final grades, yet the outcome was statistically significant for only one of the courses. In the downstream courses, the non-honors students from the test cohort tended to have better outcomes, but there was only one significant difference for the five courses. Compared with the non-honors students from the control cohort, a modestly greater proportion of non-honors students from the test cohort left the engineering major, but the difference in the proportions was not statistically significant.

Table 4. Grade Outcomes for Non-Honors Students in Courses the Semester Following the Core Courses Examined in this Study

	Fall 2014 Cohort			Fall 2015 Cohort			
	N	Mean	Std. Dev.	N	Mean	Std. Dev.	P value
ENGR:2710	66	2.82	0.66	98	3.11	0.60	.0002
ENGR:2730	37	2.32	1.11	33	2.21	0.91	.3848
ENGR:2750	85	2.33	0.86	92	2.57	0.76	.0652
ECE:2400	38	2.57	1.14	26	2.81	0.83	.1059
ECE:2410	42	2.59	0.77	27	2.88	1.25	.0776

DISCUSSION

We undertook this study in reaction to engineering faculty's concern that establishing honors sections of engineering core courses would put at risk the peer-to-peer mentoring that normally occurs in heterogeneous sections of those classes. Several studies have focused on what happens to the peer effect when students are grouped according to academic ability, and they suggest that the formation of a separate group of high-ability students will negatively affect the academic performance of the middle- and low-ability groupings (Betts & Shkolnik; Zimmer). Also, the extensive scholarship on peer effects in education indicates that, at least under certain conditions and for certain outcomes, peer effects have a modest influence on students' academic performance (for surveys of the research, see Sacerdote, "Peer Effects" and "Experimental"; Epple & Romano), suggesting that separating honors students might negatively affect the academic performance of non-honors students.

Negative consequences, however, did not occur for the courses that were part of our study. Even though the honors sections of the core courses were homogeneous (i.e., almost all honors students), the non-honors sections were not: that is, honors students in our study did not exclusively enroll in the honors sections of the fall 2015 core courses. Instead, because of scheduling conflicts, lack of interest, or possibly intimidation by the novelty of honors sections, many honors students enrolled in the non-honors sections (see Tables A3–A5 in Appendix B for the numbers). The median proportion of honors students in non-honors sections of core courses in the test cohort (fall 2015) was ~17%, with a range from 13% to 36%, compared to the control cohort (fall 2014), where the median proportion of honors students in the core courses was ~31%. In the test cohort of fall 2015, the non-honors students still had a fairly substantial proportion of honors students as classmates in the core courses: enough, we judge, to create a peer effect. Therefore, although we can say that the creation of honors sections of the core courses did not hurt the academic performance of the non-honors students, we cannot conclude that removing all honors students (or some higher percentage) from classes would have no effect on the academic performance of non-honors students.

That said, although studies have indicated that under certain conditions peer effects have a modest influence on students' academic performance, identifying and then measuring peer effects are difficult. As a result, conclusions are contradictory, particularly in the case of peer effects on academic performance (see Sacerdote "Experimental"; Feld & Zölitz). In fact, several recent studies on the peer effect in the classroom at the post-secondary level find that middle- and low-ability students are not disadvantaged by the removal of high-ability students from classes (Martins & Walker; Hoel et al.; Parker et al.). For example, a recent study by Parker et al. at three selective liberal arts colleges in the Pacific Northwest tracks possible peer effects on the academic performance of students who have taken small, discussion-based core courses that have a humanities orientation. Nearly all first-year students must take the core courses, and they have little control over their selection of sections. The study uses as its principle measure of outcomes grades in courses taken after the core courses in order to avoid any effect an instructor's curving of grades in the core courses may have on peer effects. The data from this careful study show "no support whatsoever for the hypothesis that students in core courses benefit from more able peers" (18). Their belief, based on interviews with the instructors of the core courses that were part of the study, was that the most relevant peer characteristics are not based on academic ability but on students' "attitude and personality" (23).

Because the results of studies on peer effects regarding academic performance have been mixed and even contradictory, we feel more confident that the results of our own study are not an anomaly and would hold even if the percentage of honors students in the non-honors section went down. Moreover, creating honors sections of classes at the post-secondary level will rarely if ever result in homogeneous groupings of the non-honors sections: high-ability students, whether honors or not, will always be present in the sections.

CONCLUSION

The results of our study showed some positive and negative outcomes for the test cohort of non-honors students. For the core courses in the first analysis, the outcomes were mixed as the non-honors students in the test cohort achieved better outcomes in one course, worse outcomes in a second, and statistically the same in the third. Thus, the results for the test cohort were neutral for this part of the study. We also found that non-honors students in the test cohort did not achieve significantly different final grades in four of the selected downstream engineering courses; in fact, they performed better in one course, on average, than the non-honors students in the control cohort. One possible negative outcome could be the modestly greater proportion of students who left the engineering major at the end of the spring semester following the fall term in which they took the core courses, but this negative outcome is small and represents a difference of only eleven additional students who left engineering (less than 3% increase from the previous year). Also, the students who changed their major may have done so for reasons not related to their academic performance in the core engineering classes. Thus, the results of our study suggest that the establishment of honors sections of the core courses did not negatively affect the academic outcomes of non-honors students, but we are aware of the limited scope of our study and the need to extend this type of evaluation to at least a five-year period in order to verify our results.

Engineering faculty who expressed concern for establishing honors sections frequently mentioned the risk to effective peer-to-peer mentoring that honors sections posed. Should future offerings of honors sections become more popular among honors students, concern about peer-to-peer mentoring may be more appropriate, but research on peer effects for academic performance has produced mixed and even contradictory results. It may be that, despite common perceptions, high-ability peers do not have a positive effect on the academic performance of middle- and low-ability students. Moreover, high-ability students will always be present in non-honors engineering core courses: either honors students who choose not to take an honors section or high-ability students who are not part of the honors program. Finally, many colleges, including the University of Iowa College of Engineering, offer peer tutoring to first- and second-year students. For all these reasons, we feel confident in our conclusion that implementing honors sections does not adversely affect the academic performance of students in non-honors sections.

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APPENDIX A

Principles for Teaching and Grading Honors Courses and Principles for Defining Honors Contracts

The following are general principles for teaching engineering courses designated as Honors courses open only to Honors students. See also the comments from the University of Iowa Honors Program (https://honors.uiowa.edu/faculty-staff):

Principle: Honors Courses and Honors Contracts are Designed for Honors Students

- Only Honors students may enroll in Honors designated sections.
- Students enrolled in non-honors sections may request an honors contract but the decision to accommodate the request is up to the instructor. There is no expectation that engineering faculty accommodate these requests. Students are restricted to only one Honors Contract.

Principle: Honors Courses Students Should Not Be Penalized with a Harder Grading Curve

- Courses that include honors sections should not be curved by section because the distributions of letter grades is expected to be different in each section and different than they have been in the past.
- Common exams and coordinated grading among the honors and regular sections of a course is a good way to assure fair grading of all sections of the course.
- In general, we prefer a fixed grading policy rather than a curve so that students are not pitted against each other but instead required to meet the professor's expectations.
- The course policy for grading fairly must be published in the course and section syllabi.

Principle: Honors Courses and Honors Contracts Obligations Require Measurably Broader, Deeper, or More Complex Engagement of the Subject Material

- Homework assignments are more complex.
- Projects are more numerous and require deeper understanding of the problem and may have additional components such as a presentation in oral or written form.
- Honors students may participate in researching and teaching relevant concepts.
- "Work done for an honors contract should be qualitatively different in nature from that already assigned for the class." (https://honors.uiowa.edu/faculty-staff/honors-contract)

Principle: Honors Courses Embrace Experiential Learning

- Honors students are expected to participate in discussion.
- Active learning is promoted in the classroom while passive learning (books, podcasts) is expected outside of class.
- Instructors take risks with new pedagogy that promotes experiential learning.

APPENDIX B

Table A1. Demographic Information for Fall 2014 Cohort

	Not Honors		Honors		Chi-square	*p* value
	n	Col. %	n	Col. %		
First Generation Status					0.84	0.36
Continuing Generation	238	79.87%	140	83.33%		
First Generation	60	20.31%	28	16.67%		
Gender					51.93	<.0001
Female	54	14.29%	79	41.36%		
Male	324	85.71%	112	58.64%		
Race/Ethnicity					INVALID	
African American or Black	8	2.12%	5	2.62%		
Asian	13	3.44%	11	5.76%		
Hispanic or Latino(a)	21	5.56%	11	5.76%		
Multi-Racial	5	1.32%	4	2.09%		
Native Hawaiian or Pacific Islander	1	0.26%	1	0.52%		
Nonresident Alien	29	7.67%	11	5.76%		
Unknown	26	6.88%	11	5.76%		
White, not of Hispanic or Latino(a) origin	275	72.75%	137	71.73%		
Total	378	100%	191	100%		

Table A2. Demographic Information for Fall 2015 Cohort

	Not Honors		Honors		Chi-square	*p* value
	n	Col. %	n	Col. %		
First Generation Status					2.22	0.14
Continuing Generation	269	76.42%	118	82.52%		
First Generation	83	23.58%	25	17.48%		
Gender					30.08	<.0001
Female	72	17.78%	67	39.18%		
Male	333	82.22%	104	60.82%		
Race/Ethnicity					INVALID	
African American or Black	12	2.96%	3	1.75%		
Asian	20	4.94%	10	5.85%		
Hispanic or Latino(a)	26	6.42%	12	7.02%		
Multi-Racial	13	3.21%	2	1.17%		
Native Hawaiian or Pacific Islander	2	0.49%	0	0%		
Nonresident Alien	35	8.64%	24	14.04%		
Unknown	11	2.72%	9	5.26%		
White, not of Hispanic or Latino(a) origin	286	70.62%	111	64.91%		
Total	405	100%	171	100%		

Table A3. Distr. of Honors Students in ENGR:2110 Sections

	Not Honors		Honors		Total N
	N	Row %	N	Row %	
Fall 2014					
000A	51	69.86%	22	30.14%	73
000B	78	75.73%	25	24.27%	103
000C	56	76.71%	17	23.29%	73
TOTAL	185	74.23%	64	25.77%	249
Fall 2015					
000A (Honors)	1	3.03%	32	96.97%	33
000B	95	87.16%	14	12.84%	109
000C	68	86.08%	11	13.92%	79
000D	36	75.00%	12	25.00%	48
TOTAL	200	74.35%	69	25.65%	269

Table A4. Distr. of Honors Students in ENGR:2120 Sections

	Not Honors		Honors		Total N
	N	Row %	N	Row %	
Fall 2014					
000A	76	52.05%	70	47.95%	146
000B	114	70.37%	48	29.63%	162
TOTAL	190	61.69%	118	38.31%	308
Fall 2015					
000A	98	63.64%	56	36.36%	154
000B	115	85.19%	20	14.81%	135
000C (Honors)	1	2.78%	35	97.22%	36
TOTAL	214	65.85%	111	34.15%	325

Table A5. Distr. of Honors Students in ENGR:2130 Sections

	Not Honors		Honors		
	N	Row %	N	Row %	Total N
Fall 2014					
0001	73	68.87%	33	31.13%	106
0002	103	68.67%	47	31.33%	150
TOTAL	176	68.75%	80	31.25%	256
Fall 2015					
0001	79	83.16%	16	16.84%	95
0002	108	75.00%	36	25.00%	144
0003 (Honors)	2	5.41%	35	94.59%	37
TOTAL	189	68.48%	87	31.52%	276