Peer Effects and Gender in the College Classroom

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Introduction and Context

The presence of peer effects in higher education has been investigated in an extensive empirical literature. Studies have addressed the impact of peer academic ability on own academic performance[i];the effects of other peer characteristics such as family income[ii], leadership ability or fitness[iii] on own academic performance; and the effects of peer characteristics on other behaviors such as the decision to join a Greek organization or athletic team[iv], academic major [v]. The presence or absence of peer effects could have important ramifications for decisions about "school choice, affirmative action, busing, distance learning, mainstreaming, selective admissions, and the rise of merit scholarships" [vi]. Students may benefit from higher ability peers if the peers improve comprehension of course material through class discussion or study groups[vii] or if students mimic the study habits of higher ability peers[viii]. Peer effects may also justify college selectivity[ix].

In this paper, we estimate the effects of average peer academic ability on own GPA in the first semester of college using data on two cohorts of students from a small, selective liberal arts college. We define three different types of peer groups -- roommates, dormitory floormates, and classmates -- both overall and by gender. We find no peer effects from roommates, floormates, or classmates in general. However, we do find evidence of selective classroom peer effects when we separately consider one's own-gendered and other-gendered peers. Specifically, male students perform significantly better when their male classmates have higher average academic performance but do not respond to female peer academic performance. Females respond to neither own-gender or general peer performance.

The existing empirical evidence of peer effects is mixed. Sacerdote (2001), Winston and Zimmerman (2003), and Stinebrickner and Stinebrickner (2005) find that roommate academic ability (measured through SAT scores and other pre-college measures) has a significant and positive effect on own GPA. Zimmerman (2003) finds no effect of roommate total SAT but does find a small but positive and significant effect of roommate verbal SAT score. Carrell et. al. (2008) also find significant effects of peer verbal SAT, but unlike Sacerdote and Winston and Zimmerman, they find this at the squadron level and not at the roommate level.[x] Foster (2006) finds weak evidence of peer effects while Lyle (2007) finds no significant effect of peer academic ability on own academic performance.[xi]

The size of peer effects appear to depend on where one falls in a school's academic distribution. Sacerdote (2001), Zimmerman (2003), and Winston and Zimmerman (2003) extend their analysis of peer effects by integrating variables that capture where one's roommate falls in the institution's academic distribution. Sacerdote (2001) only finds peer effects when the roommate is in the top 25% while Zimmerman (2003) finds that the middle 70% shows small GPA gains when their roommate has a higher verbal SAT score but the top 15% and bottom 15% show no peer effects. Winston and Zimmerman (2003) find no peer effects for students in the top 15% of the SAT distribution at any of the three schools they study but those in the middle of the SAT distribution benefit from higher peers at one of the three schools they use while those in the bottom 15% benefit from higher SAT roommates at another of the three.

The literature also finds that peer effects vary by gender. Zimmerman (2003) finds males with academically weak roommates have lower GPAs while females with academically weak roommates have higher GPAs. The effect is still only for the middle 70%. Stinebrickner and Stinebrickner (2005) only find peer effects for females[xii] while Foster (2006) primarily finds peer effects for men. Winston and Zimmerman (2003) find significant peer effects for both genders, finding that mid distribution males are

pulled down by lower distribution males while mid distribution females are pulled up by higher distribution females.

There are several econometric challenges in estimating peer effects[xiii]. One of these is selection. Students may tend to gravitate towards students similar to them and so using social groups to estimate peer effects is likely problematic as the students have self-selected into certain groups. One way to deal with this problem is to use roommate data. This approach -- used by Sacerdote (2001), Zimmerman (2003), Stinebrickner and Stinebrickner (2005), and Carrell et al. (2008) -- avoids the selection problem when roommate assignments are random. Other random groups – such as assignment to military squadrons (Lyle 2007, Carrell et. al. 2008) – can also be used. Another selection problem may exist at the institutional level. Stinebrickner and Stinebrickner (2005) and Foster (2006) point out that Sacerdote's and Zimmerman's use of data from extremely selective schools (Dartmouth and Williams) may explain why peer effects observed are small.[xiv] Stinebrickner and Stinebrickner (2005) and Foster (2006) avoid this by using less selective schools (Berea College and the University of Maryland) while Winston and Zimmerman (2003) use data from three different schools.

Empirical Framework and Results

This paper estimates academic peer effects in the first semester of college at the roommate level, the dormitory floor level, and the classroom level[xv]. For each of these groupings, we determine the effect of average first semester peer academic rating (an index based on high school grades and SAT or ACT scores) on a student's first semester GPA. We face a selection problem we since a student's first semester GPA is only observed if they finish the first semester which we account for by using a Heckman selection model, estimating GPA conditional upon a student finishing the first semester (i.e. $RET_i = 1$). Our model is as follows:

$$GPA_i = f(A_i, PM_i, CE_i, PE_i | RET_i^*) + \varepsilon_i$$

$$RET_i^* = f(PM_i, CE_i, F_i) + \omega_i$$

Our GPA equation includes two variables that capture a student's own academic ability (A_i), academic rating and original writing level[xvi]. We also include number of pre-matriculation (PM_i) student characteristics. To capture a student's preparedness for college as well as their college expectations, we include a dummy variable indicating whether a student's high school offered fewer than 3 AP courses or 3 or more[xvii], whether the student attended a public high school (private or parochial represent the base case), home community's degree of urbanization (metropolitan area represents the base case), and time of deposit. We also include demographic variables to account for a student's gender and race.

We incorporate several variables relating to a student's academic and co-curricular experience within the institution (CE_i) including major and/or division (i.e. social sciences, humanities, or life sciences), academic credit load, and average quality of the student's instructors. To estimate the quality of instructors, we use the scores on two questions on the standardized evaluations that the students fill out at the end of the semester.[xviii] We also include whether or not a student was an athlete because that likely enhances the student's connection to the institution.

Finally, to capture peer effects (PE), we include variables for the average academic rating of a student's roommates, the average academic rating of a student's dormitory floor, and the average academic rating of a student's classmates. We interact these variables with gender to determine whether peer effects differ by gender. For the average class academic rating, we also calculate the average male academic rating in the class and the average female academic rating.

The selection equation (RET_i) also includes student pre-matriculation variables, academic and co-curricular experience within the institution, and peer effects. In addition, the retention equation includes

two variables reflecting a student's financial constraints (F_i). Our dataset was collected from a small selective private liberal arts college. Unless otherwise noted, all data were retrieved from a central college administrative database. The data contains students who entered in Fall of 2006 and those who entered in the Fall of 2007. (Fall, 2008 cohort data will be incorporated shortly.)

Our preliminary results are shown in Table 1[xix]. The academic ability variables (A) are both significant and have the expected positive signs. The pre-matriculation variables indicate that students from public high schools with more than 3 AP courses perform better in their first semester, as do students from micropolitan areas. Females, white students, students with more academic credits, and members of the college honor society also earn higher GPAs.

In our first regression, on average males perform significantly worse than females. However, these first order gender differences disappear once we include gender-defined peer effects in the empirical model. Specifically, we find no mean difference in performance by gender once we control for gender-based peer groups but we do show that male students perform significantly better when their male classmates have higher average academic performance.

TABLE 1		***Coefficient***		***Coefficient***	
A	***Academic rating***	0.0946	***	0.0946	***
	Original writing level	0.2509	***	0.2525	***
PM	***High school offered fewer than 3 AP courses***	-0.1734	**	-0.1772	**
	High school type (1 = public)	0.3303	***	0.3178	***
	Hometown (1= micropolitan area)	0.2458	***	0.2263	***
	Gender (1 = male)	-0.2204	***	-0.8304	
	Race (1=white)	0.1047	**	0.1007	**
CE	***Total academic credits in first semester***	0.0788	***	0.0797	***
	Member of college honors program	0.4518	***	0.4554	***
PE	***Average class academic rating***	-0.0463		-0.2690	
	Average floor academic rating	-0.0481		-0.0161	
	Average room academic rating	-0.0032		-0.0111	
	Interaction between gender and average class academic rating			-0.0540	
	Interaction between gender and average floor academic rating			-0.0888	
	Interaction between gender and average room academic rating			0.0149	
	Interaction between gender and average male class academic rating			0.3979	**
	Interaction between (1-gender) and average female class academic rating			0.1068	

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[i] Sacerdote (2001), Zimmerman (2003), Stinebrickner and Stinebrickner (2005), Lyle (2007), Carrell et. al. (2008)
[ii] Stinebrickner and Stinebrickner (2005)
[iii] Carrell et. al (2008)
[iv] Sacerdote (2001)
[v] Sacerdote (2001), Lyle (2007)
[vi] Zimmerman (2003), p 9
[vii] Stinebrickner and Stinebrickner (2005)
[viii] Stinebrickner and Stinebrickner (2005), Zimmerman (2003). Stinebrickner and Stinebrickner (2005) also present survey results indicating that roommates tend to spend a lot of time tougher (about 22 hours a week), especially females.
[ix] Zimmerman (2003), Carrell et. al. (2008), Winston and Zimmerman (2003)
[x] Carrell et. al. (2008) data is drawn from the U.S. Air Force Academy and so peer group can be defined at the residential level (roommates) or the larger social and academic unit, squadrons. Carrell et. al. are also able to break out peer effects at the course level and find that peer effects exist in math, science, humanities and social science courses but not foreign language or physical education courses.
[xi] Lyle (2007) is also able to test for role model peer effects as his data is drawn from West Point and first year companies but finds no academic peer effects of role models. Carrell et al (2008) test for effects from upper-classmen in a student' squadron
[xii] Another important contribution of Stinebrickner and Stinebrickner (2005) is their attempt to estimate the "net gains" of peer effects.
[xiii] Manski (1993) and Betts and Shkolnik (2000) review of the major econometric challenges in peer effects work.
[xiv] Stinebrickner and Stinebrickner (2005) use Berea College as their sample.
[xv] We believe that estimating peer effects at the classroom level should not present selection problems, at least in the first semester. Students choose their classes during the summer before their first semester without communication with other students and so the course selection process is likely not correlated with academic indices. Beyond the first semester, it is likely that students choose classes based on the decisions of their social groups and so selection is more problematic.
[xvi] A student's writing level is determined by a placement test in the summer before their freshman year.
[xvii] Data used was drawn from the College Board's Enrollment Planning Service (EPS®)
[xviii] The standardized tool administered at this college is the SUMMA.
[xix] Insignificant variables not listed include pioneer, small town hometown, rural hometown, major/division controls (only nursing significant), instructor quality, and athlete. Significant variables not listed include nursing major, late deposit, need, and aid.