

Peer Effects from Alcohol Use Among College Students^{*}

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Abstract

This paper estimates peer effects by taking advantage of random assignment of roommates through a housing lottery at a large state university. We find no evidence that roommates' high school grades, admission test scores, or family background affects students' GPA. However, male students' college GPAs are 1/4 point lower if their roommate drank alcohol in high school. There is no similar effect for females. The effects are stronger at the lowest quantiles of the GPA distribution. Effects are also strongest for those students who themselves reported drinking frequently in high school, suggesting that policies such as substance free halls which cause students who drink to room together could potentially worsen overall university academic performance. Initial assignment to a roommate who drank in high school has just as strong or even stronger effect on sophomore GPA as on freshman GPA. This may be because initial roommate assignment has a multiplier effect by influencing subsequent choices of peer groups.

1 - Introduction

Alcohol abuse is a major problem on college campuses, with 40% of students reporting binge drinking at least once within two weeks of being surveyed (Wechsler et al., 2000). Many researchers argue that substance abuse is subject to substantial peer effects (Botvin et al., 1998; Cumsille et al., 2000; Leibsohn, 1994; Brook et al., 1990; Reis and Reily, 2000; Wechsler et al., 1995). Such views provide rationale for a number of policies adopted by universities in response to alcohol problems, such as establishing substance-free housing, launching public relations campaigns to persuade students that their classmates drink less than they think, and counseling those with substance abuse problems to avoid the company of those with whom they abused the substance. However, it is often difficult to empirically distinguish whether the correlation between peers' outcomes is due to peer effects, to self-selection of similar peers, or to common shocks affecting the peer group.

We address the selection problem by taking advantage of a natural experiment in which students are randomly assigned to roommates through a lottery system. Sacerdote (2000) adopts this approach, but whereas Sacerdote finds evidence of contemporaneous correlation in college roommates' GPA, we focus on the effect of roommates' pre-college characteristics on students' college performance, thus distinguishing the peer effect hypothesis from the hypothesis that roommates are subject to common shocks. We also have access to a sample of students who selected their own roommates, which allows us to analyze the importance of the selection problem in this context.

With the exception of Sacerdote (2000) and Zimmerman (1999), most studies done in the context of roommate assignment in colleges and universities have either not focused on assessing peer effects or not addressed satisfactorily the selection problem.³

We find no evidence that roommates' prior academic performance affects a student's academic performance in college, as measured by GPA. However, male students' college GPAs are 1/4 point lower if their roommate drank alcohol in high school. There is no similar effect for females. The effects are stronger at in the lowest quantiles of the GPA distribution, and for those students who reported drinking frequently in high school.

This paper is organized as follows. Section 2 describes the data used. Section 3 examines the random assignment assumption. Section 4 shows that our data exhibit the same type of correlation in roommate GPA as found by Sacerdote, and argues that it is difficult to determine whether this is due to peer effects or correlated shocks. Section 5 presents our alcohol results and Section 6 concludes.

³ By and large, these studies have not addressed important methodological issues. Some studies have controlled for initial observed differences in students, but most of the research done in this area has been based on static group comparisons, post-test only control group designs, and a lack of adequate controls for initial differences in students (Blimling, 1993). Other studies have used samples of randomly assigned roommates but have failed to take advantage of this randomization to address the selection problem. They have simply compared students that were randomly assigned with others that were assigned according to a specific (non-random) criteria. The main interest of these studies has not been to assess the magnitude of peer influences, but rather to determine which assignment method is best (in terms of generating better student outcomes).

2 - Data

Our data are taken from a large, academically strong, state university.⁴ Before their arrival at the university, first year students mail in their housing applications, in which they list four basic housing preferences (smoking/non-smoking room, single/double/triple occupancy, geographic area of campus, and gender composition of corridor), and whether they want to live in an enrichment living center or to request a specific roommate. Appendix A describes in detail the information students submit in their housing applications. Students who meet the lottery deadline (usually around April 25th) are randomly assigned to their rooms unless they elect to live in an enrichment living center, in which case they need to submit an essay to be considered for admission, or they select a specific roommate, in which case the housing office will honor the request as long as it is mutual.

For students who met the lottery deadline, a computer randomly assigns to each of these students a lottery number. The student with lottery number 1 gets assigned first to a room that meets his/her basic housing preferences. Then the student with the next lowest lottery number who has the same housing preferences and gender as student 1 will get assigned as his/her roommate. This process continues until the room is filled. The whole process is repeated subsequently for students with lottery numbers 2, 3..., up to the highest lottery number.

The result of the process described above is to assign students in the lottery sample randomly to their rooms, conditional on gender and the four basic housing preferences. Hence the assignment should be random within a given cell (combination of gender and basic housing preferences). Appendix B presents a diagram detailing the way we chose our sample. As can be seen, not all students are assigned randomly. Our main sample (henceforth called the "lottery sample") consists of those students who met the lottery deadline, did not request a particular roommate, elected not to live in an enrichment living center, and lived with at least one roommate. There is a second group of students who requested their roommate, which will be used for comparison purposes and is termed the "roommate request sample."

Several data sources were used in this study. The housing office provided us with data on the contents of each student's housing application and on actual occupancy. The registrar provided information on GPA and choice of major. An additional source of data was obtained from the Entering Student Survey.⁵ This questionnaire is filled in by entering students at many universities around the country and it contains detailed information on student background (parental education, income, extracurricular activities during the last year of high school, goals they have set for themselves, activities they plan to conduct in the future, etc). In the case of the particular university in our study,

⁴ The university is considered as "highly competitive" in Barron's Profile of American Colleges(2000) .

⁵ This survey is part of the Cooperative Institutional Research Program (CIRP), a national longitudinal study of the American higher education system that was started in 1966 by the American Council on Education. It is now conducted jointly by the Council and the University of California, Los Angeles. This study offers pre-college characteristics of first year college students that serve as a baseline profile of the undergraduate student population.

entering students fill in the survey at the orientation session (before classes begin) and the response rate is very high (89% for the 1997 survey).

Most students meet their roommate when classes start. However, some students may meet their roommate at the beginning of orientation (before filling in the survey) and some may have spoken with the roommate on the phone before arriving to the university. Information on when roommates meet or speak with each other for the first time is not available but, according to housing officers, if roommates met before filling in the CIRP survey they are likely to have done so for a very brief period of time.

We initially had data on 3,967 first year students from the 1997 entering class. As explained above, not all of these students can be used in our study. In particular, 26% of students decided to live in enrichment living centers and 12% of the students requested a roommate. About 26% of the students lived alone during the first year. Finally, only 42% of the students met the lottery deadline. In the end, 903 students remained in our sample.

Since the randomly assigned sample is a subset of the total population of entering students, a natural question to ask is whether those who were randomly assigned are very different from those who are not. Table 1 compares descriptive information across the three groups: the lottery sample, the whole sample, and the roommate request sample. The lottery sample contains a slightly larger proportion of females than the other two samples and a much smaller percentage of black students (3% in the lottery sample vs. 7% in the whole sample and 11% in the roommate request sample). Academically, lottery students seem to perform slightly better (as measured by cumulative GPA in both college and high school) although they do not score higher on the admissions test.

Differences between students who met the lottery deadline and did not request roommates and the rest of the students in the university would not bias our estimates of peer effects within the lottery sample but may make it difficult to generalize our results to the larger university population.

Table 1 also provides descriptive statistics on the drinking behavior of students in the year previous to filling in the Entering Student Survey (which, by and large, corresponds to their last year of high school). The survey contains two drinking-related questions: "Drank beer?" and "Drank wine or liquor?"⁶ There were three possible answers to each of these questions: frequently, occasionally, and not at all. We classified as "high drinkers" those who answered "frequently" to at least one of the two drinking-related questions. We classified as "medium drinkers" those who answered "occasionally" to at least one of the two drinking-related questions, and who were not classified as "high drinkers." The remaining students were classified as "non-drinkers."

Since some students took only the SAT, others took only the ACT, and some took both, a common admissions test score measure was needed as an academic background variable. We therefore standardized test scores based on concordance tables (published by both ACT, Inc. and the College Board)⁷, which are used by many admissions offices around the country (including the one in this study). We then restandardized this

⁶ Response rates for these questions are above 98% of those who filled in the Entering Student Survey (also known as the CIRP survey)

⁷ One of the many reports in which these tables are published is authored by Pommerich et al (2000).

measure by subtracting the sample mean and dividing over the standard deviation of the sample. Hence the regression coefficients on this variable can be readily interpreted as the change in the dependent variable associated with an increase of a standard deviation over the mean of the admissions test scores.

For each student in our sample, the roommate variables were determined by averaging over all roommates. Given that 78% of students in our sample only had one roommate (table 1.b), sample sizes were too small to examine whether the average is better than other measures (such as the minimum or maximum) at capturing the relevant roommate information.

Finally, when we use the term “roommate” we are referring to the roommate *initially* assigned to the student when entering the university. If a student changed roommates, we are not using the information on the new roommate because this would raise the possibility of self-selection and may therefore bias our results.⁸ The university does not allow roommate changes during the first six weeks of classes (except for extreme cases involving violence), and strongly discourages any roommate changes during the first year.⁹ According to housing officials, less than 5% of students switch roommates during their first year, and thus instrumenting for actual roommates characteristics with initial roommate characteristics would lead to peer effect estimates very similar to the ones we obtained.

3 - Random assignment checks

Information from the university suggests that students from the lottery sample with the same housing preferences and gender should be randomly assigned to their roommates and residence halls. This section checks whether initial roommates' background characteristics were significantly correlated.

To assess whether the roommate assignment process was truly random, we ran regressions in which student background characteristics (such as admissions test score, high school GPA, parental background, activities done in high school, goals, views, etc.) were regressed on their corresponding initial roommates' average and a set of housing preferences dummy variables (representing the above described "cells"). If the housing assignment process were truly random within cells and if answers to the questions in the survey were not affected by communication between roommates prior to filling out the CIRP questionnaire, roommate characteristics should be uncorrelated in expectation. Of course, if one examines enough roommate characteristics, some of them will be correlated by chance. To the extent that observable characteristics are correlated, controlling for own characteristics will address the problem. The real danger would be omitted variable bias due to correlation in unobserved variables. If housing assignment is random, this possibility will be accurately reflected in reported standard errors.

⁸ For example, one may think that a student usually would switch to a roommate that is more similar /compatible than the initial roommate. If this is the case, and we used actual roommate (instead of initial roommate) information in our regressions, our peer effect estimates could simply be reflecting self-selection.

⁹ It turns out, according to some students at this university, that different dorms and floor counselors have different philosophies about allowing roommate changes instead of resorting to conflict resolution and other methods. Information on this is not systematic enough to exploit in our empirical work.

Nine out of 75 regression coefficients turned out significant for the lottery sample, out of which five had a positive sign and the remaining four had a negative sign.¹⁰ Although we are reasonably confident that these results are consistent with random assignment, the number of significant coefficients is slightly larger than we expected. At the moment, we can think of two possible explanations: (i) it is possible, though not very prevalent according to housing officers, that some students spoke with their roommate before they filled in the survey. If this is the case, these roommate pairs may exhibit higher correlations in their responses to the survey than would be warranted by how truly similar or dissimilar they are. We currently do not have data on which roommates communicated among themselves before filling in the survey; (ii) we ideally would like to have data on initial roommate (as assigned by the housing assignment software) but instead we have data on initial room occupancy. We therefore defined "initial roommates" as those students who occupied the same room on the first day of the academic term. According to the Housing Office, this is practically the same as the roommate groups produced by the housing assignment software. There is, however, a small chance that this may have generated a number of significant coefficients slightly larger than expected.

The variable 'Drank Beer' is one in which the roommates' average has a significant coefficient (though the variable 'Drank wine' does not). Therefore, when analyzing the effect of roommates' past drinking behavior on student outcomes (Section 5), we control for own past drinking behavior. Note that the housing office did not have access to the responses from the Entering Student Survey (where the drinking variables appear), so they could not have possibly matched students on the basis of the drinking variables or any other variable that appears in this survey. Also note that the drinking variables used in the regression analysis of Section 5 are based on the variables 'Drank Beer' and 'Drank wine' but do not appear to be correlated across roommates.¹¹

Also note that there is no evidence for a type of influence that could lead to false inferences of peer effects. In particular, if roommates communicated before filling out the CIRP questionnaire, and if students with high drinking roommates raised their standards for what constituted "frequent" drinking and thus were more likely to classify themselves as drinking "occasionally" rather than "frequently," we might observe a negative effect of roommate drinking on own GPA, controlling for own drinking in high school. However, we can test for this, because it would also produce a negative correlation between roommate reports of high school drinking, which we do not observe. Any bias in the other direction, in which light drinkers with heavy drinking roommates

¹⁰ We further assessed the random assignment assumption by calculating correlations between students and their roommates within each major subgroup (females, males, coed halls, etc.), for the whole set of available background variables. We then plotted these correlations and verified that by and large there seems to be little evidence of an association between a student's background and his/her roommates' background.

¹¹ The results from our random assignment checks still leave open the possibility that several roommate background variables may be jointly associated with a given student background characteristic. We ran regressions similar to the ones described earlier but this time several roommates' background characteristics were used as explanatory variables in each regression. A test was performed on the joint significance of these background variables and the hypothesis of random assignment for the lottery sample is again not rejected.

seek to portray themselves as heavier drinkers, will lead us to underestimate the effect of roommate drinking on outcomes.

For comparison purposes, we ran the same regressions but for the "roommate request" sample. In contrast to the lottery sample, we found 24 cases in which the roommates average background variables were positively and strongly associated with a student's own background variables, suggesting that there is significant self-selection within this group.

4 - Correlation in student college GPAs

Table 2 shows a positive association between own GPA and roommates' GPA, although the coefficients are only significant for males. The size of the effect for males is about 0.14. Sacerdote (2000) also finds that student outcomes during their freshman year at Dartmouth are positively associated with their roommates' outcomes, but finds little effect of roommates' pre-college background on student outcomes. Roommates' outcomes could be correlated for a number of reasons. Roommates could be subject to common shocks. For example, roommates may choose the same teaching assistant in classes they take together, and if teaching assistants vary in ability or grading standards this will produce correlation in roommates' GPAs. Roommates will have the same resident advisor in their dorm, and the resident advisor's attitude toward enforcing alcohol policies will produce correlation in drinking behaviors. Roommates share a dorm room, and to the extent that the rooms differ in size, quality, soundproofing of walls, or convenience to the library, classroom, student center, and local bars, roommate outcomes will be correlated. Correlation in roommate outcomes could also be due to joint decision making. For example, if two students each have a 50% chance of seeing a movie or studying on a particular night, but want to go with their roommate, roommate outcomes may be correlated, but a student's probability of studying does not depend on his or her roommate assignment. Finally, student outcomes could be influenced by pre-determined roommate characteristics. Observation of correlation in roommates' GPA is not sufficient to disentangle these hypotheses.

The main outcome we examined is cumulative GPA at the end of the summer of 1999, which corresponds to GPA at the end of the sophomore year. All regressions include controls for the set of housing preferences variables.¹²

5 - Results on alcohol

Table 3 shows that, when we look at the lottery sample as a whole, roommates' background variables (high school GPA and admissions test score) are not significantly

¹² Interactions between housing dummies are also included, which amounts to fixed-effects regressions in which the unit of observation is the cell (i.e. combination of values of four housing variables and the gender dummy). Huber-White standard errors are calculated using clusters at the relevant level (roommate, corridor, or building).

associated with a student's college GPA. We also find no effect of parental background characteristics (father's schooling, mother's schooling and parental income).¹³

Table 3 also suggests that when we look at males and females together, there is not a significant effect of roommates high school drinking on student outcomes. However, when we break up the lottery sample by gender, roommates' drinking behavior during high school affects students' GPAs for males. The effect of roommates' past drinking behavior is large, negative and significant for males. Although the point estimates are positive for females, they are not significant, and when we used our larger sample (which includes the 1997 and 1998 cohorts) the positive sign of the effect is no longer there.^{14,15}

The magnitude of the peer drinking effect for males is about -0.25 for a high drinking roommate and -0.23 for a medium drinking roommate. Both of these effects are relative to having roommates who never drank in high school. Thus having a roommate who drank frequently or occasionally in high school is associated with a decrease of about 1/4 points in a student's GPA. This effect is equivalent to 0.45 standard deviations of a student's college GPA (for the lottery sample). For comparison, the effect of having a high drinking roommate is about three times the size of the effect of a one standard deviation increase in a student's own admissions test score, and it is slightly larger than the effect of a 1/2 point increase in a student's own high school GPA.¹⁶

Since our drinking variables were constructed based on survey questions in which the students only had three possible answers to report their past drinking behavior (never, occasionally, or frequently), these variables are likely to be measured with error, which would mean that our coefficients may actually be understating the true effect of roommates' past drinking behavior.

Since the coefficients in our two drinking variables (high drinking roommate and medium drinking roommate) were similar, we also ran our regressions grouping the two drinking variables into one. In these regression, the new drinking variable had a very similar coefficient (-0.24) and a larger level of significance ($t=-3.12$).

¹³ We examined this issue in a more systematic manner by using as explanatory variables a full set of roommates' background characteristics that appear in the CIRP data set. Significance tests of several sub-groups of variables indicated no significant associations between roommates' background characteristics and student outcomes.

¹⁴ Note that about 15% of males in the lottery sample reported drinking frequently in high school compared with 12% of females, and about 50% of males reported drinking moderately compared with 56% of females. So the sensitivity of the alcohol result to gender is not due to lack of power from having a small sample of females who reported drinking in high school.

¹⁵ These regressions also control for student's own drinking behavior during high school. Column (4) has separate dummies for whether the person drank frequently or occasionally during high school. After controlling for high school GPA, having drank frequently in high school does not seem to affect a student's university GPA whereas having drank occasionally in high school is positively associated (almost at the 10% level) with a student's university GPA. A possible explanation for this result is that any negative effect that drinking may have on university GPA is already reflected in high school GPA. When we control only for whether the student drank frequently in high school (column 5), the coefficient on this variable is negative and significant (at the 10% level).

¹⁶ When we ran analogous regressions for the sample of students who selected their own roommates, the drinking variables were not significantly associated with a student's GPA. A possible explanation for this difference between the lottery sample and the roommate request sample is that in the latter the effect of having a friend that drinks frequently may have already occurred (prior to attending college).

Interaction effects

Table 4.B suggests that the effect of roommates' drinking on a student's GPA seems largest for students who reported drinking frequently in high school (although note the small sample size for this group). For male students who drank frequently in high school, a high drinking roommate is associated with a 0.76 point lower GPA.¹⁷

We also more formally explored differences in peer effects among sub-groups by using the whole lottery sample, and including in our regressions interactions between the drinking variables and a dummy variable indicating the sub-group of interest. These regressions confirm our main results: strong peer drinking effects for males but not for females, and particularly large negative effects (on the order of 0.57 points of GPA) for high drinking males.¹⁸

Other interactions

We also explored a number of hypotheses related to the drinking effects described above. For example, we assessed whether the effect of drinking would be stronger for students living in substance-free halls. We also explored whether more religious people (as measured by frequency of attendance to religious services during high school) were less subject to the peer drinking effects. We also assessed whether students were more subject to be influenced by their roommate if their roommate was similar to them (as reflected in the number of similar responses to the CIRP questionnaire). None of these hypotheses was confirmed by our empirical analysis.

Effect on Distribution of GPA

While the previous analysis has examined how roommates' high school drinking affects mean GPA, Table 5 shows how roommate's drinking affects the entire distribution of GPA. Roommates' drinking does not seem to simply cause a uniform downward shift in GPA, but rather to greatly reduce the lower tail of GPA, to somewhat decrease median GPA, and to have a smaller impact on the upper tail of GPA. Given the large standard errors associated with quantile regressions, we also report a specification that combines medium and high drinking into a single variable.

¹⁷ We explored peer effects for other sub-samples classified according to characteristics such as religion, high school GPA, admissions test score, etc., but did not find any results that would lead us to explore further these sub-samples.

¹⁸ All the results presented in this section hold when we use a sample that includes the 1998 cohort, except for the result that alcohol drinking during high school has a positive (and almost statistically significant) effect on college GPA for females. When we used the 1997 and 1998 cohorts, we found no evidence that alcohol drinking was even mildly related to college GPA for females.

Dynamics of peer effects

Peer effects seem to persist, and perhaps even strengthen over time. Male students whose roommates were high drinkers in high school have GPAs 0.18 lower in their first year and 0.33 points lower in their second year (see table 6), although the difference in these coefficients is not statistically significant. One potential explanation for this finding is that students' first year roommates affect their subsequent choice of social group, which in turn affects their future behavior. For example, a student assigned a first-year roommate who drinks may also have many other dorm-mates who do not drink much, and hence may drink only moderately during the first year of college. But the drinking roommate may want to move to a high-drinking fraternity his second year, and if the student goes with him, then the initial tendency toward association with drinkers may strengthen over time, and with it, the roommate effect on own GPA. It would be ideal to assess whether the effects last longer than sophomore year but, unfortunately, we currently do not have data that would allow us to conduct such an assessment.

Level of aggregation

We explored whether the effects we observed varied according to the number of roommates a student has. Almost 80% of students in our sample have only one roommate. Restricting our baseline regressions to the sample of students with one roommate makes practically no difference on the magnitude of coefficients of our drinking variables. The standard errors were slightly larger, but statistical significance of the coefficients was preserved.

We also explored whether peer effects occurred at the levels of the corridor or building. In contrast to our results at the roommate level, results suggest that peer effects are not present at the corridor or building level, either for the sample as a whole or for the male sub-sample.

Selection

By comparing results obtained using the lottery sample with those obtained using the roommate request sample, we can assess the extent to which the selection (or endogenous membership) problem was present in the context of this study. The conclusion seems to depend on which regressions are analyzed.

As observed in Section 3, the degree of association between a student's own background characteristics and that of his/her roommates is very strong for the roommate request sample and very weak (or non-existent) for the lottery sample. This led us to expect that the estimated peer effects should be much stronger for the roommate request sample than for the lottery sample. As Table 8.A shows, this is not the case. First, "academic" peer effects, as measured by the coefficients on the roommates' academic background variables, are insignificant for both samples. Secondly, "drinking-related"

peer effects, as measured by the coefficients on the roommates past drinking behavior, are present for the lottery sample and not for the roommate request sample.¹⁹

On the other hand, regressions of outcomes on outcomes (Table 9.B), yield stronger effects in the roommate request sample. For the lottery sample as a whole, a one point increase in one's roommates' average GPA is associated with a 0.08 increase in one's own GPA. For the roommate request sample this number is on the order of 0.34. The results are not the same for males, though.

Sorting scenarios

Table 9 summarizes the effect on average GPA for several hypothetical sorting scenarios. Each case focuses on the subsample of males and assumes that the coefficients for roommates' high school drinking (listed in Table 4.B) are the true peer effects on a student's college GPA. The first scenario illustrates the dramatic difference in average GPA (0.287) between a situation in which two high drinkers room together and two non-drinkers room together, and a situation in which the non-drinking students room with the high drinking students. The second case shows the increase in average GPA that results when the high-, medium-, and non-drinking students of the roommate request group move from their actual situation to one in which they are randomly matched. In this case, the increase in average GPA is much smaller, because few heavy drinkers in high school were matched together, and it is breaking up these groups that has the biggest effect on average GPA. In a student population with more drinkers (such as the one perhaps present at a less competitive university), this effect would have been more pronounced. The third case, positive assortment, shows the difference in GPA within the lottery sample caused by moving from random assignment to a situation in which students in the lottery sample with similar alcohol habits are matched with each other, that is, high drinking students room with other high drinking students, medium-drinkers with other medium-drinkers, and non-drinkers with other non-drinkers. Alternatively, the lottery sample could be sorted negatively, or, in other words, high drinkers with non-drinkers. This case yields a small but positive increase in the average GPA relative to random assortment. In general, the hypothetical situations suggest that minimizing the number of high drinking roommate matches—may temper the impact that alcohol drinking has through roommate peer effects.

6 - Conclusions

This paper assesses the magnitude of peer effects in the context of living arrangements at a large state university. It addresses an important methodological problem-- selection or endogenous membership-- present in most of the existing literature, by exploiting a natural experiment in which people are randomly assigned to their peers.

¹⁹ As explained earlier, one possible explanation for the lack of significance of the drinking variables in the roommate request sample is that any negative effect that drinking may have on a student's academic performance is already reflected in his/her own high school GPA or admissions test score.

We find that roommates' past drinking behavior has a large, negative effect on males' GPA. We find no significant effect for females. For males, having a roommate who drank frequently or occasionally in high school is associated with a decrease of 0.25 points in a student's GPA. This effect is equivalent to almost half a standard deviation of a student's GPA (for the lottery sample) and slightly larger than the effect of a 1/2 point increase in a student's own high school GPA.

We also find that the effects are larger for students in the lowest quantiles of the college GPA distribution and for those students who reported drinking frequently in high school.

The paper also finds that the drinking effects seem to persist and perhaps even strengthen over time. Male students whose roommates were high drinkers in high school have GPAs 0.18 lower in their first year and 0.33 points lower in their second year, although the difference in these coefficients is not statistically significant.

In the context of the drinking effects mentioned above, the results are consistent with several mechanisms. One possibility is that roommates influence each others' drinking behavior during the first year of college (by going out to drink together, for example). But another possibility is that there may be some attitudes or behaviors associated with frequently drinking that affect a student's outcome. For example, a roommate that frequently drinks may have a tendency to be disruptive and this may have an effect on a student's performance in college. Given that we find particularly strong results for students who themselves drank frequently in high school, and that the roommate effect is concentrated in the bottom quantiles of the GPA distribution, we believe the first of the two possibilities above seems more likely.

It is natural to ask whether some of these results can be generalized more broadly to other settings. A natural reference setting would be other educational institutions such as secondary schools. On the one hand, college students are older and hence may be less subject to peer influences. But on the other hand, college students generally live away from home and hence may be more subject to peer influences. Overall, it seems difficult to predict if our estimates of peer effects are larger or smaller than those likely to be present in other contexts.

We find that peer effects are related to roommate behavior (drinking) but not to socio-economic background or academic ability. In this context, this seems to suggest that attempts to improve outcomes for at-risk students should perhaps focus not so much on mixing students of different academic ability or socio-economic status, but on peers' behavior. Our analysis, however, suggests that segregating people who drink together may be particularly problematic.

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Table 1- Main Descriptive Statistics

	Lottery Sample (1)			Whole Sample ²⁰ (2)			Roommate request sample (3)			Difference between (1) and (2)	Difference between (1) and (3)
	N	Mean	Std. Dev	N	Mean	Std. Dev	N	Mean	Std. Dev		
Outcomes											
Cum. GPA 1999	900	3.10	0.56	3,950	2.93	0.85	359	2.93	0.75	**	**
Cum. Credits 1999	900	55.68	8.40	3,950	52.50	14.50	359	52.58	12.28	**	**
Demographics											
Proportion of females	900	0.52	0.50	3,956	0.51	0.50	361	0.44	0.50		*
Proportion of blacks	903	0.03	0.17	3,967	0.08	0.27	361	0.13	0.33	**	**
Academic Background											
Admissions Test Score (standardized)	875	0.00	0.86	3,821	0.00	1.00	345	-0.09	1.02		**
High School GPA	891	3.60	0.39	3,927	3.54	0.45	360	3.53	0.45	**	**
Parental background											
Father's years of Schooling	896	16.31	2.07	3,905	16.19	2.29	359	15.91	2.64		**
Mother's years of Schooling	900	15.72	2.19	3,943	15.70	2.25	359	15.59	2.30		
Parental Income (in 000's of \$)	818	120.12	74.44	3,631	116.80	78.61	324	112.97	78.92		

²⁰ The number of observations in the lottery and roommate request samples do not add up to the number of observations in the whole sample because there is a large number of students who did not meet the lottery deadline (and hence were assigned non-randomly) and did not choose a particular roommate.

Table 1 (continued)- Main Descriptive Statistics

	Lottery Sample (1)			Whole Sample (2)			Roommate request sample (3)			Difference between (1) and (2)	Difference between (1) and (3)
	N	Mean	Std. Dev	N	Mean	Std. Dev	N	Mean	Std. Dev		
Housing Preferences											
Substance Free Hall	903	0.33	0.47	3,900	0.35	0.48	356	0.34	0.47		
No Smoking Roommate	903	0.60	0.49	3,900	0.56	0.50	356	0.53	0.50	**	*
OK Smoking roommate	903	0.00	0.00	3,900	0.02	0.13	356	0.02	0.15	**	**
Smoker	903	0.07	0.26	3,900	0.08	0.27	356	0.11	0.31		**
Single Room	903	0.03	0.17	3,967	0.08	0.27	361	0.02	0.13	**	
Double Room	903	0.87	0.34	3,967	0.81	0.39	361	0.91	0.28	**	
Triple Room+Economy	903	0.10	0.30	3,967	0.11	0.31	361	0.07	0.26		*
Coed Hall, single sex corridor	903	0.43	0.50	3,967	0.40	0.49	361	0.37	0.48	*	
Coed Hall, coed corridor	903	0.53	0.50	3,967	0.53	0.50	361	0.61	0.49		
All-Female Hall	903	0.03	0.18	3,967	0.04	0.19	361	0.01	0.12		
Geographic area of campus “A”	903	0.71	0.45	3,967	0.63	0.48	361	0.60	0.49	**	**
Geographic area of campus “B”	903	0.22	0.42	3,967	0.28	0.45	361	0.36	0.48	**	**
Geographic area of campus “C”	903	0.06	0.24	3,967	0.06	0.24	361	0.02	0.15		**
No Living Learning Center	903	1.00	0.00	3,967	0.77	0.42	361	0.71	0.46	**	**
Drinking background											
Proportion who drank frequently in high school	903	0.14	0.34	3,967	0.15	0.35	361	0.17	0.38		
Proportion who drank occasionally in high school	903	0.53	0.50	3,967	0.52	0.50	361	0.50	0.50		

* significant at the 5% level ** significant at the 1% level

Table 1.b - Distribution of roommates

(a) For Whole sample

	Freq.	Percent	Cum.
1	2320	78.78	78.78
2	601	20.41	99.19
3	20	0.68	99.86
4	4	0.14	100.00
Total	2945	100.00	

(b) For Lottery sample

	Freq.	Percent	Cum.
1	701	77.63	77.63
2	192	21.26	98.89
3	10	1.11	100.00
Total	903	100.00	

Table 2- Relation between own GPA and Roommates' Average GPA. Lottery Sample

	Whole (lottery) sample			Males only		
	(1)	(2)	(3)	(4)	(5)	(6)
Roommates' average college GPA	0.082 (0.049)	0.079 (0.048)	0.070 (0.053)	0.144* (0.064)	0.142* (0.061)	0.137* (0.063)
Roommates' parental background						
Roommates' Avg Father's Education			0.015 (0.014)			0.021 (0.021)
Roommates' Avg Mother's Education			-0.004 (0.012)			-0.013 (0.017)
Roommates' Avg Parental Income			0.000 (0.000)			0.000 (0.001)
Roommates' high school activities						
High drinking roommate			-0.057 (0.062)			-0.227* (0.095)
Medium drinking roommate			-0.050 (0.054)			-0.225** (0.083)
Student's own academic background						
Standardized Admission test score		0.112** (0.025)	0.126** (0.027)		0.113* (0.044)	0.103* (0.045)
High school Gpa		0.424** (0.054)	0.408** (0.057)		0.487** (0.086)	0.458** (0.091)
Student's parental background						
Father's education		0.037** (0.012)	0.035* (0.014)		0.041* (0.019)	0.037 (0.020)
Mother's education		-0.007 (0.012)	-0.006 (0.012)		-0.006 (0.016)	-0.004 (0.017)
Parental income		0.000 (0.000)	0.000 (0.000)		0.000 (0.000)	0.000 (0.000)
Student's high school activities						
Drank beer or wine frequently		0.043 (0.069)	0.024 (0.074)		0.021 (0.109)	0.001 (0.121)
Drank beer or wine occasionally		0.126* (0.053)	0.115* (0.057)		0.125 (0.086)	0.143 (0.095)
Observations	890	769	710	420	369	348
R ²	.136	.268	.239	.125	.245	.211
Adjusted R ²	.061	.190	.146	.043	.150	.096

Robust standard errors in parentheses. * significant at 5% level; ** significant at 1% level

Dummy variables for housing preferences and gender (and interactions between these variables) included in all regressions. Huber-White standard errors were calculated using roommate clusters. All regressions include dummies for which admissions test the student took.

Table 3- Effect of Roommates' Background Characteristics on Cumulative GPA at the End of Summer 1999. Lottery Sample

	Specification				
	(1)	(2)	(3)	(4)	(5)
Roommates' academic background					
Roommates' Avg Stdized Test Score	-0.002 (0.025)	0.002 (0.027)	0.002 (0.030)	0.003 (0.029)	0.003 (0.030)
Roommates' Avg High School GPA	0.048 (0.066)	0.038 (0.074)	0.063 (0.083)	0.048 (0.082)	0.054 (0.083)
Roommates' parental background					
Roommates' Avg Father's Education			0.019 (0.014)	0.018 (0.014)	0.018 (0.014)
Roommates' Avg Mother's Education			-0.007 (0.012)	-0.007 (0.012)	-0.006 (0.012)
Roommates' Avg Parental Income			0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Roommates' high school activities					
High drinking roommate				-0.068 (0.064)	-0.065 (0.064)
Medium drinking roommate				-0.047 (0.055)	-0.042 (0.056)
Student's own academic background					
Standardized Admission test score		0.114** (0.026)	0.129** (0.028)	0.130** (0.028)	0.131** (0.028)
High school GPA		0.415** (0.055)	0.396** (0.059)	0.402** (0.059)	0.394** (0.059)
Student's parental background					
Father's education		0.038** (0.013)	0.035* (0.015)	0.034* (0.015)	0.034* (0.015)
Mother's education		-0.006 (0.012)	-0.004 (0.013)	-0.002 (0.013)	-0.003 (0.013)
Parental income		0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Student's high school activities					
Drank beer or wine frequently				-0.010 (0.077)	-0.096 (0.061)
Drank beer or wine occasionally				0.113* (0.057)	
Observations	859	741	691	689	689
R ²	.102	.222	.224	.234	.228
Adjusted R ²	.021	.138	.131	.136	.131

Robust standard errors in parentheses. * significant at 5% level; ** significant at 1% level

Dummy variables for housing preferences and gender (and interactions between these variables) included in all regressions. Huber-White standard errors were calculated using roommate clusters. All regressions include dummies for which admissions test the student took.

**Table 4.A- Effect of Roommates' Background Characteristics on Cumulative GPA at the end of Summer 1999.
For Sub-Samples of Lottery Sample**

	Whole	Sub-sample	
	Lottery Sample	Females	Males
Roommates' high school drinking			
High drinking roommate	-0.068 (0.064)	0.144 (0.085)	-0.252** (0.093)
Medium drinking roommate	-0.047 (0.055)	0.119 (0.075)	-0.228** (0.082)
Roommates' parental background			
Roommates' avg. Father's education	0.018 (0.014)	0.008 (0.019)	0.023 (0.022)
Roommates' avg. Mother's education	-0.007 (0.012)	0.006 (0.017)	-0.016 (0.017)
Roommates' avg. Parental income	0.000 (0.000)	0.000 (0.000)	0.000 (0.001)
Roommates' academic background			
Roommates' avg. admissions test score	0.003 (0.029)	-0.023 (0.039)	0.041 (0.045)
Roommates' avg. high school GPA	0.048 (0.082)	0.082 (0.104)	0.005 (0.136)
Student's own academic background			
Standardized admission test score	0.130** (0.028)	0.144** (0.033)	0.104* (0.047)
High school GPA	0.402** (0.059)	0.353** (0.070)	0.450** (0.097)
Student's parental background			
Father's education	0.034* (0.015)	0.022 (0.019)	0.035 (0.021)
Mother's education	-0.002 (0.013)	-0.003 (0.019)	0.001 (0.018)
Parental income	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Student's high school activities			
Drank beer or wine frequently	-0.010 (0.077)	0.073 (0.089)	-0.074 (0.124)
Drank beer or wine occasionally	0.113* (0.057)	0.125 (0.072)	0.132 (0.092)
Observations	689	351	338
R ²	.234	.280	.192
Adjusted R ²	.136	.165	.068

Robust standard errors in parentheses. * significant at 5% level; ** significant at 1% level.

Dummy variables for housing preferences and gender (and interactions between these variables) included in all regressions. Huber-White standard errors were calculated using roommate clusters. All regressions include dummies for which admissions test the student took.

**Table 4.B- Effect of Roommates' Background Characteristics on Cumulative GPA at the end of Summer 1999.
For Sub-Samples of Lottery Sample. Males only**

	Males only	Sub-Sample of Males		
		Did not drink in high school	Drank Occasionally in high school	Drank Frequently in high school
Roommates' high school drinking				
High drinking roommate	-0.252** (0.093)	-0.070 (0.193)	-0.139 (0.125)	-0.796** (0.270)
Medium drinking roommate	-0.228** (0.082)	-0.243 (0.152)	-0.238* (0.116)	-0.428 (0.248)
Roommates' parental background				
Roommates' avg. Father's education	0.023 (0.022)	0.105* (0.043)	-0.020 (0.038)	-0.070 (0.065)
Roommates' avg. Mother's education	-0.016 (0.017)	-0.107* (0.041)	0.029 (0.031)	0.087* (0.038)
Roommates' avg. Parental income	0.000 (0.001)	0.000 (0.002)	0.001 (0.001)	-0.001 (0.002)
Roommates' academic background				
Roommates' avg. admissions test score	0.041 (0.045)	0.057 (0.092)	0.028 (0.049)	-0.054 (0.153)
Roommates' avg. high school GPA	0.005 (0.136)	0.358 (0.342)	-0.124 (0.137)	-0.079 (0.280)
Student's own academic background				
Standardized admission test score	0.104* (0.047)	0.080 (0.085)	0.038 (0.066)	0.401* (0.145)
High school GPA	0.450** (0.097)	0.391 (0.216)	0.507** (0.142)	0.386 (0.281)
Student's parental background				
Father's education	0.035 (0.021)	0.047 (0.048)	0.004 (0.037)	0.169 (0.131)
Mother's education	0.001 (0.018)	0.019 (0.040)	-0.009 (0.023)	-0.084 (0.082)
Parental income	0.000 (0.000)	-0.001 (0.001)	0.000 (0.001)	0.002 (0.002)
Student's high school activities				
Drank beer or wine frequently	-0.074 (0.124)			
Drank beer or wine occasionally	0.132 (0.092)			
Observations	338	115	172	49
R ²	.192	.361	.242	.608
Adjusted R ²	.068	.123	.010	.182

Robust standard errors in parentheses. * significant at 5% level; ** significant at 1% level

Dummy variables for housing preferences and gender (and interactions between these variables) included in all regressions. Huber-White standard errors were calculated using roommate clusters. All regressions include dummies for which admissions test the student took.

Table 5 – Quantile regressions
Coefficients and standard errors on roommates' drinking variables
Males from Lottery sample

	Quantiles				
Quantile	10%	25%	50%	75%	90%
GPA associated with quantile	2.248	2.705	3.096	3.425	3.684
Specification #1:					
High drinking roommate	-0.23 (0.23)	-0.33* (0.14)	-0.27** (0.10)	-0.21 (0.12)	-0.15 (0.11)
Medium drinking roommate	-0.34 (0.27)	-0.31* (0.15)	-0.18 (0.10)	-0.10 (0.09)	-0.05 (0.09)
Specification #2:					
Drinking roommate	-0.33 (0.19)	-0.32** (0.11)	-0.19 (0.10)	-0.10 (0.07)	-0.07 (0.09)

Bootstrapped standard errors in parentheses. * significant at 5% level; ** significant at 1% level
 Same controls as in Tables 4.A, 4.B, and 4.C are used (roommates' academic and parental background, own academic, parental and socioeconomic background, and admissions test dummies). Dummy variables for housing preferences and gender (and interactions between these variables) included in all regressions.

Table 6- Peer Effects Dynamics. Sample: Males from Cohort 97 in Lottery Sample

	Outcome	
	1998 GPA [GPA 1 st year]	1999 GPA [GPA 2 nd year]
Roommates' high school drinking		
High drinking roommate	-0.176* (0.087)	-0.328** (0.119)
Medium drinking roommate	-0.171* (0.072)	-0.212* (0.102)
Roommates' parental background		
Roommates' Avg. Father's Education	0.013 (0.017)	-0.001 (0.023)
Roommates' Avg. Mother's Education	-0.024 (0.015)	-0.003 (0.020)
Roommates' Avg. Parental Income	0.001 (0.000)	0.001 (0.001)
Roommates' academic background		
Roommates' Avg admissions test score	0.029 (0.042)	0.023 (0.050)
Roommates' Avg High School GPA	-0.064 (0.134)	-0.129 (0.110)
Student's own academic background		
Standardized Admission test score	0.117** (0.041)	0.029 (0.051)
High school Gpa	0.476** (0.100)	0.452** (0.120)
Student's parental background		
Father's education	0.031 (0.020)	0.054* (0.025)
Mother's education	-0.001 (0.016)	-0.008 (0.021)
Parental income	0.000 (0.000)	-0.001 (0.001)
Student's high school activities		
Drank beer or wine frequently	-0.090 (0.106)	-0.270 (0.149)
Drank beer or wine occasionally	0.107 (0.077)	0.022 (0.089)
Observations	338	328
R ²	.219	.191
Adjusted R ²	.099	.065

Robust standard errors in parentheses. * significant at 5% level; ** significant at 1% level. Dummy variables for housing preferences and gender (and interactions between these variables) included in all regressions. Huber-White standard errors were calculated using roommate clusters. All regressions include a cohort dummy and dummies for which admissions test the student took.

Table 8.A- Effect of Roommates' Background Characteristics on Cumulative GPA at the end of Summer 1999. Lottery Sample vs. Roommate Request Sample

	Females and males		Males only	
	Lottery sample	Roommate request sample	Lottery sample	Roommate request sample
Roommates' high school drinking				
High drinking roommate	-0.068 (0.064)	-0.097 (0.196)	-0.252** (0.093)	-0.083 (0.253)
Medium drinking roommate	-0.047 (0.055)	-0.064 (0.107)	-0.228** (0.082)	0.016 (0.156)
Roommates' parental background				
Roommates' Avg Father's Education	0.018 (0.014)	-0.036 (0.021)	0.023 (0.022)	-0.042 (0.044)
Roommates' Avg Mother's Education	-0.007 (0.012)	0.028 (0.027)	-0.016 (0.017)	-0.012 (0.036)
Roommates' Avg Parental Income	0.000 (0.000)	0.001 (0.001)	0.000 (0.001)	0.001 (0.001)
Roommates' academic background				
Roommates' admission test score	0.003 (0.029)	0.004 (0.062)	0.041 (0.045)	0.052 (0.068)
Roommates' Avg High School GPA	0.048 (0.082)	0.047 (0.141)	0.005 (0.136)	-0.028 (0.146)
Student's own academic background				
Standardized Admission test score 2	0.130** (0.028)	0.109 (0.070)	0.104* (0.047)	0.129 (0.087)
High school Gpa	0.402** (0.059)	0.472** (0.136)	0.450** (0.097)	0.432** (0.161)
Student's parental background				
Father's education	0.034* (0.015)	-0.009 (0.024)	0.035 (0.021)	0.003 (0.041)
Mother's education	-0.002 (0.013)	0.016 (0.027)	0.001 (0.018)	-0.020 (0.029)
Parental income	0.000 (0.000)	0.002** (0.001)	0.000 (0.000)	0.003* (0.001)
Student's high school activities				
Drank beer or wine frequently	-0.010 (0.077)	0.229 (0.170)	-0.074 (0.124)	0.327 (0.206)
Drank beer or wine occasionally	0.113* (0.057)	0.026 (0.131)	0.132 (0.092)	-0.024 (0.180)
Observations	689	266	338	160
R²	.234	.372	.192	.355
Adjusted R²	.136	.211	.068	.167

Robust standard errors in parentheses. * significant at 5% level; ** significant at 1% level
 Dummy variables for housing preferences and gender (and interactions between these variables) included in all regressions. Huber-White standard errors were calculated using roommate clusters.

**Table 8.B- Effect of Roommates' Average GPA on Student's Own GPA.
Lottery Sample vs. Roommate Request Sample**

	Females and males		Males only	
	Lottery sample	Roommate request sample	Lottery sample	Roommate request sample
Roommates' average college GPA	0.079 (0.048)	0.340** (0.122)	0.142* (0.061)	0.181 (0.151)
Student's own academic background				
Standardized Admission test score 2	0.112** (0.025)	0.079 (0.056)	0.113* (0.044)	0.089 (0.074)
High school GPA	0.424** (0.054)	0.360** (0.114)	0.487** (0.086)	0.398* (0.163)
Student's parental background				
Father's education	0.037** (0.012)	-0.002 (0.019)	0.041* (0.019)	0.009 (0.031)
Mother's education	-0.007 (0.012)	0.007 (0.020)	-0.006 (0.016)	-0.032 (0.029)
Parental income	0.000 (0.000)	0.002** (0.001)	0.000 (0.000)	0.003** (0.001)
Student's high school activities				
Drank beer or wine frequently	0.043 (0.069)	0.258* (0.125)	0.021 (0.109)	0.337* (0.163)
Drank beer or wine occasionally	0.126* (0.053)	0.020 (0.098)	0.125 (0.086)	-0.010 (0.144)
Observations	769	298	369	175
R ²	.268	.429	.245	.358
Adjusted R ²	.190	.310	.150	.219

Robust standard errors in parentheses. * significant at 5% level; ** significant at 1% level

Dummy variables for housing preferences and gender (and interactions between these variables) included in all regressions. Huber-White standard errors were calculated using roommate clusters. All regressions include dummies for which admissions test the student took.

Table 9: Effect of Changing Sorting on GPA

Mixing two high- and two non-drinkers	0.363
Relative to Random Assortment	
<hr/>	
Positive Assortment	-0.073
Negative Assortment	0.035
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Elimination of Substance Free Housing *	
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For Students Formerly in Substance Free Housing	-0.028
For Students Formerly Not in Substance Free Housing	0.079
Overall Effect of Eliminating Substance Free Housing	0.051

* Changes expressed per student in substance free housing

Appendix A - Information contained in application for student housing

PERSONAL INFORMATION

- Contact information (Name, Address, Telephone number, E-mail, etc.)
- Gender

BASIC HOUSING PREFERENCES

- Environment preference: substance free housing, non-smoking roommate, don't mind roommate smoking, smoker.
- Room Type Preference: Single, Double, Triple+Economy
- Corridor type preference: All female hall, Coed Hall/single sex corridor, Coed Hall/coed corridor
- Campus area preference: A, B, or C.

OTHER HOUSING PREFERENCES

- Whether want to apply to living learning communities (requires separate application process with an essay)
- Whether want to choose a roommate (student must list name of desired roommate)

Appendix B

