

Can we select the right peers in Indian Education?

Evidence from Kolkata¹

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This paper will look at the effects of random dormitory assignment in a tertiary educational institution in Kolkata on subsequent academic achievements. We are particularly interested in finding out whether random variation in peer group composition generates peer effects and what the general nature of this peer effects is. The detailed nature of the dataset also allows us to separate out the peer effects to see if students from disadvantaged socio-economic backgrounds like rural regions and backward classes such as Scheduled castes and Scheduled Tribes, do better in higher education when assigned particular privileged peers via such random dormitory allocation. The overall results of the paper suggest that residing with high-ability peers improves academic achievements of the good peers but generates large negative peer effect for the low ability students assigned to the same room. We also find robust evidence that students from backward classes benefit significantly from high ability students belonging to the general classes, but no such positive effect exists among those originating from rural regions and non-English backgrounds. The results are however somewhat mixed if different definitions of urban residence are considered.

Keywords: tertiary education, peer effects, friendship effects, backward classes

JEL codes: I18, I23, I25

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1. Introduction

High economic growth coupled with targeted investments in primary and secondary education in India has developed a sizeable middleclass, with high hopes and aspirations for their children. This transformation, driven mostly by socio-economic and demographic changes has resulted in an increased demand for higher education (Patnaik 2000; Wadhva 2000). According to OECD (2012) by 2020, about 40% of the world's university graduates (in the 25-34 year age group) will be from China and India, representing a huge proportion of the global talent pool. Currently, about 1 in 10 individuals finish some form of higher education (Altbach, 2005), giving India the third largest pool of graduates after China and United States. However, only a quarter of such graduates from tertiary institutions are actually employed in steady formal jobs. So, whilst the country as a whole is planning to increase tertiary level participation rates from 11% to 15% by 2015 (National Knowledge Commission, 2007), the issue of optimal use of current resources remains a major obstacle.

One reason for the difficulties faced during higher education is the disconnect between the methods used in educational institutions before admission into tertiary level programs and during it. This is particularly true and relevant for the state of West Bengal in India, where primary and secondary level schooling is offered to all students enrolled with the West Bengal Board of Secondary Education (WBBSE) primarily in the local language, Bengali⁵, whilst the only language used in higher education at the tertiary level is English. Worse, the education system only starts teaching English from standard six. There is also a major change in the quality of textbooks and teachers, effectively making it hard for those from rural regions and educated in the local language to adjust to this sudden change.

The existing phenomenon of high university enrolment, yet low graduate employment also points to an obvious imbalance between the needs of the labour market and the provisions of the higher education institutions. According to ADB (2012) the lack of key soft skills such as communication

⁵ There are a few schools which are affiliated to the West Bengal Board of Secondary Education (<http://wbbse.org/>) but where the medium of instruction is English. Therefore, we particularly focus on the medium of instruction as the major concern: comparing educational outcomes of those from English medium versus others, and we do not distinguish between students attending different boards (Central v/s West Bengal boards) or type of schools (private v/s public institutions).

and problem-solving abilities and employable skills like English language and computer abilities has contributed significantly to such high levels of graduate unemployment and underemployment. In environments where resources are constrained, cost-effective means of improving academic outcomes may be worth considering, targeting particularly the students from under-privileged groups and rural populations as they might not be able to bridge this gap on their own.

This study uses the existence of randomised peer allocations to see whether peers can help to overcome initial disadvantages. The relevance to the wider education and growth agenda is partially the issue of the inputs that students from disadvantaged backgrounds need in order to catch up. More directly, peer allocation is an actual policy instrument in itself, both at particular institutions but also throughout the whole education system, where individuals are assigned to study groups, classes, dorms, projects, etc. Decisions on these peer groups are made at several levels within the education system, not just by school administrators but also by parents and ministries. Maximising the production of peer effects is therefore a question of policy importance.

The production of higher education is significantly affected by an unusual input — the presence of other students (referred to as “peers” in the literature), where students may learn better when in the company of other strong students than in the company of academically poor individuals. This current research on peer effects could add to the crucial debates on which policies could maximize the productivity of a country's education spending. We do not distinguish between the various mechanisms through which peer effects affect educational outcomes in this context. The literature has focussed on the effect of high school peer group characteristics on undergraduate grade (Morrell, 1999), peer effect on youth criminal behaviour and drug use (Case and Katz, 1991), hospital roommates (Kulik et al., 1996), freshmen roommate effects on grade point average (Sacerdote, 2001; Zimmerman, 2003) and neighbourhood effects on both adults and children (Jencks and Mayer, 1990; Rosenbaum, 1992; Katz, Kling and Liebman, 2001). The literature provides strong evidence that own ability is important for academic achievements but peer effects are also important, even though interactions between own and roommates backgrounds are equally relevant, as emphasized by Zimmerman (1999) and Sacerdote (2001).

We argue that not just abilities but the type of these peers also matter for academic achievements. Towards this end we separate out the peer effects based on peer background characteristics like social class, medium of instruction at school, and region of residence to investigate whether both

in-group and out-group peer effects affect academic outcomes differently. We are particularly interested in understanding whether individuals originating from poor social and geographical backgrounds can gain from the presence of the privileged in this respect. The questions that we address in this paper are as follows: Do the ‘worst’ students benefit from good peers at the expense of what those good peers could be gaining or is it possible to find win-win peer allocations? Do those from backward classes, non-English and rural backgrounds gain from those belonging to general classes, English medium schools and residing in urban regions? This paper also looks at the effects of random dormitory assignment on subsequent friendships and examines if friendships also matter for academic achievements. Using randomly assigned roommate abilities as an instrument for self-selected friends’ abilities, we are able to estimate the true value of friendship specific peer effects.

This proposed paper assesses the importance of peers and networks (both roommates and friendships) for better learning outcomes, by using detailed information from randomly assigned roommates of tertiary education students enrolled in a residential boy’s college in urban Kolkata in India. This is quite unusual in the empirical literature, and the only other examples we know are from developed countries (eg. Arcidiacono et al. 2012). The overall results suggest that peer effects do exist in tertiary education among randomly assigned roommates and they are modest in size and statistically significant. By focussing on nonlinearities in academic abilities we can conclude that while high-ability students benefit from the presence of other high ability students, their impact on low-ability students is not significantly different from the effect of other low-ability students. There seems to be some evidence favouring the conclusion that individual academic outcomes can be significantly improved by grouping students with similar (past) academic records (abilities) together, easily identifiable from application forms or mark sheets. Individual grades are not just affected either positively or negatively depending on the quality of their roommates, but they are also significantly affected by the assignment of roommates with certain non-academic background characteristics. We find robust evidence that students from both general and backward social classes benefit significantly if they have a high ability roommate from the general class, but presence of a high ability student from one of the backward classes do not affect the grades of their roommates significantly (sometimes has only a weak effect, significant only at 10% level).

The paper is organized as follows. The next section introduces the background details and literature about peer effects. Section 3 then discusses the estimation methodology, followed by a discussion of the data relevant to the estimation of both roommate and friendship specific peer effects in Section 4. Section 5 then discusses the main results of the paper, focusses on both linear and nonlinear peer effects, and separates the in-group peer effects from the out-group peer effects. The falsification test along with the friendship specific peer effects is also presented in this section. Section 6 concludes.

2. Background and Literature

Most people agree that roommates and friends matter – not just for personal wellbeing, but also for knowledge and behavioural spillovers, that help them in achieving their goals in life. Several studies have shown this to be true, particularly in the case of education (Evans, Oates and Schwab, 1992, Angrist and Lavy, 1999; Sacerdote, 2001; Zimmerman, 2003; Duncan et al. 2005; De Giorgi, Pellizzari and Redaelli, 2007; Carrell et al., 2009; Foster and Frijters, 2010; Shue, 2013). However, some of the most interesting peer effects may go beyond test scores and grades. Non-academic outcomes such as binge drinking (Duncan et al., 2005), participation in the Greek system (Sacerdote, 2001), physical fitness (Carrell et al., 2011) and attitudes toward minority students (Boisjoly et al., 2006) may all display much larger peer effects. Peer group effects have also played a prominent role in policy debates concerning ability tracking, school desegregation, affirmative action, school busing, magnet schools, and Moving to Opportunity programmes.

Sacerdote (2001) used the randomized assignment of undergraduate students at Dartmouth College to identify peer influences in academic outcomes but did not find statistically significant effects in the linear-in-means model. However, all student types were found to benefit significantly from having a roommate in the top 25% of incoming scores, with a benefit of approximately 0.06 GPA points. Zimmerman (2003) also finds somewhat similar results for randomly assigned freshman roommates at Williams College. Roommate's overall SAT score is found to have no significant effect on GPA but when student's verbal and math SAT score are entered separately in the peer effects equation, roommate's verbal SAT score is found to have a significant effect, but the roommate's math score is not. Having a roommate with one–standard deviation higher SAT verbal scores raised one's own GPA by 0.02 to 0.03 points. Similarly, Stinebrickner & Stinebrickner

(2006) also found that students benefit from being assigned roommates who had higher high school GPAs. Foster (2006), however, did not find evidence of roommate effects at the University of Maryland. Siegfried & Gleason (2006), who also examined randomly assigned first-year roommates at Vanderbilt University, did not find any effect of roommate's high school GPA or SAT score on own GPA.

In the last ten years, several studies⁶ have attempted to measure peer effects across many settings and for many outcomes, but the detection and measurement of such peer effects for developing countries is often found wanting. Jain and Kapoor (2014) analyzed the impact of random and simultaneously assigned peers in both study groups as well as residential dorms on academic outcomes using data from an elite business school in India. The overall results suggest that while informal social interaction with roommates has a significant positive impact on academic achievement, the effect of study groups is small and insignificant. The effect of roommate's GMAT score on own grades is found to be quite high — about a third of the student's own GMAT score. The impact of such peer effects on students with different socio-economic and demographic characteristics on the other hand is both scarce as well mixed. In another study focussing on another leading management school in India, Sen et. al. (2012) found that while the proportion of higher caste students has a significant positive impact on lower caste (Scheduled Caste and Schedule Tribe) students in the academic and social peer group, it has a negative impact on other higher caste students. Sekhri (2011), however, finds that the college exit test scores for low caste students are adversely affected by the average quality of high caste students in their peer group.

This paper exploits the exogenous variation in one's peer group to look at the effects of random dormitory assignment on subsequent friendships and educational outcomes in a particular tertiary education institution in Kolkata, India, more representative of the overall population, with an aim of finding out how much peer effects matter, what the general nature of peer effects is, which peers matter and whether peer allocation can be optimised further to attain better educational outcomes. Another relevant question that we address is the symmetry of peer effects; do the 'worst' students benefit from good peers at the expense of what those good peers could be gaining or is it possible to find win-win peer allocations? We are also particularly interested in understanding if students

⁶ See Sacerdote (2014) for a brief survey of the literature on peer effects.

from non-English backgrounds, rural regions and backward classes like Scheduled castes and Scheduled Tribes, do better in higher education when assigned particular privileged peers via dormitory allocation. If these peer group effects are substantial, government policy may exploit them by optimally grouping students in different classrooms to achieve desired educational outcomes.

3. Econometric Methodology

In the simple and standard analytical framework usually adopted in the literature, own academic outcomes (achievements) are regressed on own academic ability, roommate's academic ability and roommate's academic outcomes. Using this empirical methodology, we can empirically distinguish between peer effects that are driven by individuals' backgrounds (contextual effects) (in the form of social learning as in Ellison and Fudenberg, 1995; Banerjee, 1992; Griliches, 1958) and peer effects that are driven by individuals' behaviour (endogenous effects), through information gathering as in Young (1993), agglomeration externalities or endogenous preference formation as in Romer (2000) and Glaeser (1999).

$$Outcome = \alpha + \theta_0(Roommate\ Outcome) + \theta_1(Own\ Academic\ Ability) + \theta_2(Roommate\ Academic\ Ability) + \delta X + \varepsilon \quad (1)$$

The coefficients obtained by estimating this specification, however, cannot be interpreted as causal as they are subject to the reflection problem, where the outcome of the roommate is itself endogenous, being affected by own outcome, thereby having a multiplier effect through a feedback loop, where outcomes are themselves affected by outcomes. The true peer effects can then be estimated from the reduced form coefficients, estimated using (2), the reduced form version of (1) (see Sacerdote, 2001 for a more detailed discussion). For some examples of this approach, readers are referred to Zimmerman (2003), Angrist & Lang (2004), Carrell et al. (2009), and Imberman et al. (2012).

The reduced form model used to estimate peer effects in education can then be expressed as:

$$Outcome = a + b'(Own\ Academic\ Ability) + c'(Roommate\ Academic\ Ability) + d'X + e \quad (2)$$

Our main empirical strategy will then be to regress the outcome of interest – student’s academic outcome on his own background characteristics which include his academic ability, age, caste, region of origin as well as his roommate’s background characteristics, after controlling for other individual and household level characteristics (Zimmerman, 2003; Arcidiacono et al. 2012). We use academic index as a proxy for ability, even though it is a noisy measure of ability, as we are unable to observe the true ability of an individual.

The usual problem confronted while estimating this relation is that peers are not randomly assigned but, rather, the outcome of individual choice. Individuals can generally self-select into groups and rooms. This makes it difficult to separate out the selection effect from the actual peer effect. Luckily for us, the availability of random roommate assignment allows us to demonstrate the importance of peer effects in this setting. Random assignment confirms that own and roommate’s background characteristics are uncorrelated with each other. Random roommate assignment in our analysis allows us to obtain unbiased estimates of the roommate specific peer effects. These estimates provide a lower bound on the total peer effects, measured using roommate effects as academic achievements can be affected by other peer effects such as roommates, friends, as well as by classmates.

Many attempts to test the linear-in-means model however reject the model in favour of more complex alternatives. In fact, as Hoxby and Weingarth (2005) point out, peer effects with nonlinearities may be much more interesting because nonlinearities open up the possibility that some people (or students) could be helped by a change in peers without making other people worse off. For example, if low ability students benefit from the presence of superior peers, while high ability students are not harmed by the presence of disadvantaged peers, then mixing students of different ability levels can generate social gains. Carrell et al. (2009) found that higher-ability peers at the US Air Force Academy provide greater positive peer effects for lower-ability students than for middle-ability students. On the other hand, in examining peer effects among Katrina evacuees, Imberman et al. (2012) found something of the reverse: Higher-ability peers help higher-ability students more than lower-ability students. Siegfried & Gleason (2006) also found that higher-ability roommates provide the largest benefit to other higher-ability students.

To allow for a more flexible functional form in some specifications, own academic index is further split into three indicator variables based on the distribution of the academic index and interacted with the indicator variables for the roommate's academic index. Formally, this can be written as

$$\begin{aligned} Outcome = & \beta_0 + \beta_1(own = bottom, roommate = bottom) + \beta_2(own = \\ & bottom, roommate = middle) + \beta_3(own = bottom, roommate = top) + \beta_4(own = \\ & middle, roommate = bottom) + \beta_6(own = middle, roommate = top) + \beta_7(own = \\ & top, roommate = bottom) + \beta_8(own = top, roommate = middle) + \beta_9(own = \\ & top, roommate = top) + \gamma X + u \end{aligned}$$

4. Dormitory assignment, Data and Summary Statistics

The data used in this analysis are from the graduating classes of 2014, 2015 and 2016, i.e. those who enrolled in the three year undergraduate degree (Bachelors) program between 2011 and 2013 and the two year Masters program between 2012 and 2013 at *Ramakrishna Mission Residential College (RKMRC)*, one of the residential boy's colleges in Kolkata, affiliated to the University of Calcutta. The students are all enrolled in tertiary education, live on campus and are a very representative sample, originating from all of the 19 districts in West Bengal⁷ – from rural, semi-urban as well as urban regions, both forward (general) and backward classes like Scheduled castes (SC), Scheduled Tribes (ST) and Other backward classes (OBC), and those educated in English versus other vernacular schools at the higher secondary level.

After the standard XII board exams, all students in West Bengal start sitting for college level entrance exams and many interested in non-engineering and non-medical careers prefer this institution as it is one of the few premier residential colleges in the city and is relatively cheaper compared to other similar institutions elsewhere. The eligibility criteria⁸ for the entrance exam is

⁷ The nineteen districts in the state of West Bengal are Darjeeling, Jalpaiguri, Cooch Behar, Malda, North Dinajpur, South Dinajpur, Bankura, Bardhaman, Birbhum, Purulia, Murshidabad, Nadia, West Midnapore, East Midnapore, Hooghly, Howrah, Kolkata, 24 Parganas (North) and 24 Parganas (South). Alipurduar is the 20th and newest district of West Bengal created on the 25th of June 2014, right after the end of the data collection part of the project, which lasted from February to May 2014.

⁸ The eligibility criteria for admission into UG courses is usually 60% (aggregate scores in the best five subjects in Standard XII exams, including languages and excluding Environmental Science) for Arts and 70% for Science subjects, with 5% relaxation in aggregate for SC/ST candidates, while for PG courses it is 50% (in the Honours subject) for Science and 45% for Arts, again with a 5% relaxation for SC/ST students (as part of affirmative action).

set by the Administration, and only those students who satisfy the set criterion are selected to sit for the written part of the entrance exam, after completing the application process. After the written exam, the top scorers in the college level entrance exams (upto three times the number of seats) are invited for a face to face interview, and those students with the highest composite scores are finally admitted into the degree programs. A final list of the admitted students prepared by the Administration Office is then sent to the Housing Office for room assignments. Separate student lists are prepared for those enrolled in the different programs (undergraduate and postgraduate). Students are first randomly allotted⁹ to one of the three residential halls (hostels) by the Housing Office and then into one of the hostel rooms by the respective hostel authorities, assigning only students enrolled in the undergraduate program only undergraduate students as roommates and vice versa.

Even though students are allotted rooms during the first year of their programs, they are moved to a new room every year (at the beginning of every term), but they normally remain with their initial set of roommates. Only if there are serious issues with the roommates they are assigned to a different room¹⁰, with a new set of roommates. Therefore, we can use the current room assignment as a source of random variation to identify roommate specific peer effects i.e., the roommate variables have been created using the roommate assignment as of the beginning of the current year. We have only considered rooms with more than one student, thereby averaging the roommates' effects only when more than two students are assigned to the same room.

The final dataset used in this paper originates from the institution's student database and includes residential hall assignments, information from the application forms, filled in by the students at the time of their admission, which includes detailed personal and household specific information such as household income, residential address, local guardian's details (if any), anthropometric information and a full history (semester wise breakup) of academic records since admission, received in each of the honours, general and compulsory subjects (English, second language,

⁹ Students are randomly assigned to their rooms irrespective of their academic abilities. Due to confidentiality regulations only the Administrative Office keep a copy of their past academic transcripts and use it to verify only the eligibility of the students during the application process, and this information is not shared with the Housing Office. Students with disabilities like blindness (about 1% of the sample) are however exceptions to this rule as they are usually assigned to particular rooms with specific facilities.

¹⁰ Less than 5 percent of the students in the sample ever changed rooms or their initial set of roommates, assigned by the Housing Office and the hostel authorities. The results are robust to the definition of roommate assignment used (initial or current set of roommates). Robustness results presented in the Appendix.

Environmental Science and Indian Culture and Value Education), provided directly by the Examinations Office. This data is merged with a separate set of information collected by the research team through a detailed survey specifically designed to capture different aspect of the students' lives at the institution. The final dataset is one of its kind and to the best of our knowledge the first dataset to use both administrative as well as survey information in a developing country setting. Since all administrative records are mandated to be complete and truthful, self-reporting bias, measurement error and missing data do not threaten our analysis.

Covering about 550 students from the college, this dataset has detailed information about their adolescent friendship and peer networks and their socio-economic-academic performance. The resultant database also contains a range of socio-economic and demographic variables, asking detailed questions about the respondent's personal characteristics, educational background, health status, past schooling history, social and family relationship, social network as well as information about their cognitive and non-cognitive skills. The most interesting aspect of the data is the friendship information based upon actual friend nominations, asked of all respondents. Students were asked to identify their best friends from a college roster (up to five of them). As a result of this one to one mapping we were able to reconstruct the whole geometric structure of the friendship network.

[Place Table 1 over here]

Outcome variables include (i) marks obtained in the honours (major) subject in the *current* (last) semester, (ii) *cumulative marks* in the honours subject aggregated over all the semesters and (iii) *total marks* obtained in all subjects, including honours (major), general (minors) and all compulsory subjects like English, second language (Bengali/Hindi), Environmental Science, etc. While current semester can be thought of as measuring the short term impact of peer effects, cumulative and total marks capture a more long term effect of the same. Academic Index (AI) which will be used as a proxy for the ability of these individuals, is based on their background information¹¹ and is a weighted average of their high school scores — marks secured in the

¹¹ Total marks in the board exams range all the way from 800 among the West Bengal board secondary level institutions to 1000 among students graduating from ICSE and CBSE board for the standard X exams. Standard XII marks on the other hand range from 500 for West Bengal higher secondary level students to 1000 among ISC and

Standard X and XII exams, putting equal weight on each score. Table 1 contains summary statistics for the overall sample and then also separately by the three residential halls, and finds that academic achievements are indeed uniformly distributed across the three residential complexes. All these measures of academic achievement (both school and college marks) have been rescaled to a scale of 0 to 100.

5. Results

The results section in this paper will be discussed in terms of four separate subsections, which will focus on (1) random roommate assignment, (2) roommate specific peer effects (both linear and nonlinear), (3) in-group and out-group specific peer effects, (4) a falsification test, (5) friendship specific peer effects and (6) potential mechanisms for such effects. The regression results for Equation (1-3) are presented in Tables 3, 4, 5 and 6. Tables 3 and 4 show the results of the linear effects model with both own effect and with roommate specific peer effect (as in Equation 2), while Tables 5 and 6 report the estimated coefficients for the peer effects model with nonlinearities (presented in Equation 3). As we are primarily interested in understanding the effects of both own and roommate's abilities (measured using academic index) on student's academic outcomes, we only report the relevant parameters \hat{b}' and \hat{c}' in each of the tables. However, each specification includes a full set of controls (see Appendix Table A for the full list of controls).

5.1 Testing for Random Roommate Assignment

We first test whether roommate assignments were in fact random. As discussed by Guryan et al (2013) that the typical test for the random assignment (e.g., Sacerdote 2001) of individuals to groups is not generally well-behaved. The problem stems from the fact that an individual cannot be assigned to himself. In a sense, sampling of peers is done without replacement—the individual himself is removed from the “urn” from which his peers are chosen. As a result, the peers for high-ability individuals are chosen from a group with a slightly lower mean ability than the peers for low-ability individuals. Using Monte Carlo simulation Guryan et al (2009) show that the typical test for randomization is biased when the set of individuals from which peers are drawn, as in ours,

CBSE XII students. Marks obtained in the Standard X and XII exams and Academic Index have been expressed in percentage terms (out of a total of 100) so that they can be made comparable across students from different boards.

is relatively small. The bias stems from the fact that each individual's peers are drawn from a population with a different mean ability. They proposed to control for the mean ability of all individuals in the urn, excluding individual i . The results, following Guryan et.al. (2009), are presented in Table 2. The results suggest that we should control for the mean ability of all individuals in the same category (ability quartile) in the hostel assigned initially, other than the student himself, referred to as leave-me-out ability (urn). Here the urn is the hostel. The addition of this control makes the OLS test of randomization well behaved regardless of whether average urn size is large or small. We do not find any evidence of non-random assignment. See Appendix B1 and B2 for a range of robustness checks for random roommate assignment.

[Place Table 2 over here]

5.2 Roommate specific Peer Effects

In this subsection we present the results from both the linear and the nonlinear peer effects model.

5.2.1 Linear Effects

Given the empirical framework, Tables (3)-(4) estimates the effects of own and roommate's ability on their own academic achievements, which in the presence of random roommate assignment is able to capture the true peer effect. The results presented in Table 3 suggest that peer effects do exist in tertiary education among randomly assigned roommates and are modest in size and statistically significant – the estimated roommate peer effect lies somewhere between 0.30-0.35, which is about half the size of the own effects, which lies between 0.62 to 0.75. We have used the current roommate assignment for our analysis over here, but the results are robust to the use of the initial set of assignment (results presented in the Appendix). We also include dorm fixed effects, floor fixed effects and hall fixed effects, as outcome variables of roommates could be driven by common shocks which affect all roommates together. There are a total of fifteen dorm fixed effects based on the wings (N/S/E/W)¹² in different floors of the halls, nine floor fixed effects (three in

¹² There are two wings in Hall I (North block and South Block), two in Hall II (East Block and West Block) and a single block in Hall III (with no specific names). Each room in each Hall can be easily identified by a unique Room Number (for example S-26), which identifies Room Number 26 in the South Block (direction code) of Hall I (Hall

each hall) and three hall fixed effects (see Figure 1). The peer effects results were found to be robust to the inclusion of the different fixed effects and are presented in Table 4.

[Place Figure 1 over here]

[Place Table 3 over here]

[Place Table 4 over here]

5.2.2 Nonlinear Effects

We are also interested in understanding if roommate background has a nonlinear effect on academic achievement in addition to having direct linear effect. From the results presented so far in Tables (5)-(6), we find that given their own abilities, high ability students were better off if they were in the top group of a school that sorted by ability and worst off in the bottom group. Top ability students are therefore better off if they are segregated and put among students of similar ability rather than when mixed with students of different abilities. The benefit to high-ability students (in Table 6) seem to outweigh the small loss experienced by the low-ability as a result of such hypothetical reassignment (also see Appendix C).

[Place Table 5 over here]

[Place Table 6 over here]

5.3 In-group and Out-group specific Peer Effects

In this subsection we add significantly to the existing literature by focussing on the socio-cultural-geographic characteristics of the roommates — examining whether in-group bias exists among peer effects in academic outcomes. This paper therefore decomposes the roommate specific peer effects into in-group and out-group peer effects, to understand if individuals benefit more from individuals with similar socio-economic and geographical backgrounds. This is particularly

code). See Figure 1 for map of residential complex. Detailed floor plans collected by the survey team have provided unique floor IDs as well. Floor plan can be made available upon request.

interesting as we take the effects of the roommate's characteristics a step further, beyond abilities, which had dominated the peer effects literature so far. We extend the reduced form model presented in Equation (2) to separate out the roommate peer effects into two separate peer effects based on the type of the individual's roommate — which we refer to as (i) in-group (if shares similar characteristics with the student) and (ii) out-group peer effects (different in terms of comparable characteristics).

$$\begin{aligned} Outcome = & a + b'(Academic\ Index) + c'_1(Roommate\ Academic\ Index\ if\ type\ I) \\ & + c'_2(Roommate\ Academic\ Index\ if\ Type\ II) + d'X + e \quad (4) \end{aligned}$$

This approach will help us identify if roommates with similar easily identifiable characteristics as the individual respondent might be more effective for better educational outcomes compared to others. For example, it might be interesting to note if students from backward regions or classes benefit more from similar students or from other students, from privileged backgrounds. Having a very representative sample from an institution which is so diverse in terms of the applications received allows us to separate out the roommate specific peer effects across social class (general v/s backward), region of origin (urban v/s rural) and medium of instruction at the school level (English v/s others). Each of these effects will be discussed in much detail in the subsections that follow.

5.3.1 General and Backward classes

We find that peer effects matter for students from both general and backward classes (presented in Table 7 Panel A), however, roommate specific peer effects has a much larger effect on own academic outcomes compared to own effects for students from backward classes like Scheduled Castes, Scheduled Tribes and Other Backward Classes. The results in Table 8 (Panel A) suggest that all individuals benefit from the presence of high ability general category students in their peer groups, but the effect is larger than the own effect for students from backward classes but significantly small (yet statistically significant) for students from higher castes. High ability students from low castes were also found to have a significant positive impact on other students from backward classes, but the effect was not as large as that of general category peer effects and not always significant (see Panel A in Table 8), mattered only for overall academic grades.

[Place Figure 2 over here]

[Place Table 7 over here]

[Place Table 8 over here]

5.3.2 Urban and Rural Region

We find that while roommate specific peer effects matters (in Table 7 Panel B), the type of peer effects don't (in Table 8 Panel B). Students from urban regions have no positive effect on students from rural regions. As a robustness check we also used two alternative definitions for region of residence — i) metro residents (if they are residents of Kolkata) v/s students originating from other districts of West Bengal, (ii) students from rural backgrounds v/s those from urban and semi-urban regions. These results are presented in Tables D and E in the Appendix. The overall results suggest that there is roommate specific peer effect for non-metro residents but not for metro residents (Panel A in Table D in the Appendix). The estimated roommate peer effects are only significant for non-metro individuals but not for the students from Kolkata. However, when we separate out the effects by roommate type, only metro residents seem to affect the academic outcomes of other roommates from the city (in Panel A in Table E in the Appendix) and non-metro roommates have no effect on either other roommates from the city or on similar roommates from other districts in West Bengal. Using the alternative definition of region of residence, we find that while students from non-rural backgrounds (those from semi-urban and urban regions) have no effect on other roommates, having a high ability roommate from the rural regions adversely affects the scores of those from non-rural regions (presented in Panel B of Table E in the Appendix), while students from non-rural regions have no effect on academic outcomes. It might therefore be optimal to separate out the students from rural regions from those belonging to urban and sub-urban regions.

[Place Figure 3 over here]

5.3.3 English and non-English medium of Instruction

We find that roommate peer effects matters (presented in Table 7 Panel C), but the type of peer effects matters only for students from non-English background (in Table 8 Panel C). Students from

English backgrounds¹³ have no positive effect on other students- from English and non-English backgrounds likewise, but students from non-English background seem to be helping themselves, only when overall academic performance is taken into account. High Ability students from English background was found to have a significant positive effect on roommates from similar backgrounds, only when overall marks was considered.

[Place Figure 4 over here]

5.4 Falsification Test

As a falsification test, we assign each student to a randomly chosen group from the same program, so as to assign undergraduate students only undergraduate group mates, just as in the actual roommate assignment at the institution. The idea here is to rule out the possibility of a spurious result emanating from the fact that academic grades may be positively affected by the presence of other students, both roommates and non-roommates likewise. Table 9 presents the results from our falsification tests. As expected we do not find evidence of any significant effect of the group mate's academic ability on own educational outcomes, suggesting that such peer effects are related to only randomly assigned roommates, who can be referred to as their direct peers and such positive effects that exist for roommates are not just spurious correlation.

[Place Table 9 over here]

5.5 Friendship specific Peer Effects

Next, we extend the literature by expanding the definition of peers beyond just randomly assigned roommates, dorm mates and study group mates, by estimating the importance of friendship specific peer effects for achieving better academic outcomes. Calvo-Armengol, Patacchini, and Zenou (2009) found that the individual's position in a friendship network (as measured by her Katz-Bonacich centrality) is a key determinant of their educational outcomes. A standard deviation increase in the Katz-Bonacich centrality was found to increase the student's school performance by more than 7 percent of one standard deviation. Unfortunately, the traditional approach of

¹³ Medium of instruction (English) is found to have a significant positive (robust) effect on marks obtained in the English language tests. Results available upon request.

estimating peer effects by regressing own academic outcomes on the average of friends' ability (as in Equation 2) can be terribly misleading as we have to deal with the issue of self-selection of friends. Individuals self-select friends, making it difficult to estimate such peer effects as random assignment of friends is neither possible nor applicable. Luckily for us and interestingly we can use detailed friendship information (nominations) from a carefully designed "friendship" module which asks each every respondent about their five best friends and which of these best friends are from the current institution. About two third of the respondents have nominated their roommates as their best friends (see Appendix Table F to check who is more likely to nominate roommates as friends), indicating that long term friendships are partially being decided via peer allocations and we can use randomly assigned roommate abilities as an instrument for friends' abilities. Figure 5 presents the estimated non-parametric relationship between peer academic index, which shows that friend's academic abilities is strongly correlated with roommates' academic abilities.

[Place Figure 5 over here]

[Place Table 10 over here]

The results from the estimation of friendship¹⁴ specific peer effects using the instrumental variable approach is presented in Table 10. We find that friends have a significant positive effect on own academic achievements, and the coefficients associated with friends' abilities is not significantly different from own abilities. Infact, friendship specific peer effects are found to be more important than roommate specific peer effects and as effective as own effect. Whereas, being assigned a roommate with academic abilities one point higher (measured in terms of academic index) increases current academic outcomes by 0.31 points and cumulative outcome by 0.35 points, having high ability friends (with academic index one point higher) increases these outcomes by 0.53 and 0.64 point respectively, which is almost twice as large compared to the roommate specific peer effects, discussed in much detail in the literature as well as in this current context.

¹⁴ For the purpose of our analysis we only focus on students with at least one friend from the institution. Therefore, we lose 46 students from the baseline regressions (in Table 3), when we estimate the Friendship peer effects in Table 10.

5.6 Potential Channels for such Peer Effects

The results presented so far in the last section suggest that modest and statistically significant peer effects exist among randomly assigned roommates, however, the channels through which roommates affect own academic achievements are far from clear. To understand the plausible mechanisms we use information collected using a detailed time-use module, which focuses on total time spent on (i) self-study, (ii) group-study and (iii) attending tuition classes, on an usual day (during the last four weeks) separated out by weekdays and weekends and captures the usual study habit of the individual respondents.

[Place Table 11 over here]

We find that while total time (in hours) spent studying alone (self-study) is associated with better scores in the honours (major) subject (both current as well as cumulative), effort put into group-study by the respondent himself is also associated with higher overall scores (which include both major as well as minor subjects). Most of the own effort in group study arises from group study done during the weekdays. Similarly, coefficients presented in the bottom Panel of Table 11 show that group study effort (particularly on weekdays) of the randomly assigned roommate can significantly improve own academic achievements, and the results are both robust as well as significantly larger in size than the own-group-study-effort (more than twice as much). Time spent attending tuitions on weekends was also found to affect academic performance. Group-study is therefore one of the prominent channels through which roommates affect the academic outcomes of their peers, particularly during weekdays.

[Place Table 12 over here]

To understand what other roommate specific characteristics may affect the academic outcomes of these students, we add both own as well as roommate's life satisfaction and self-assessed health variables to the usual time use variables presented in Table 11. The variable "Life satisfaction" captures the response of the student to the following question: "All things considered, how satisfied are you with your life? Pick a number between 0 and 10 to indicate how satisfied you are. Enter number from 0 to 10". The "Self-Assessed Health" variable on the other hand records their response to "In general, would you say your health is: 1 "excellent", 2 "very good", 3 "good"

4”fair” 5”poor”. These responses have been rescaled so that a response of 5 refers to “excellent” and 1 to “poor” health. We analyse the effect of both own and roommate’s life satisfaction and self-assessed health status on their academic achievements and find that the association is significantly positive (though only for life satisfaction), implying that happy roommates can have a positive effect on their roommate’s academic performance. Unfortunately, we only have life satisfaction and health information from the time of the survey, therefore, the results presented in Table 12 should be interpreted with care.

6. Conclusion and Discussion

The study of peer effects in education has occupied a prominent place in the effort to understand the determinants of educational outcomes, particularly during the last decade. The study of the effect that peers have on students’ academic achievements has joined traditional determinants such as student ability, teacher quality and parental involvement. The overall results suggest that social gains could be achieved by redistributing roommates so that the educational production function could be maximized given the other inputs into the production function, which is essential for a developing country faced with resource constraints. High ability students could therefore put in the same room with other high ability students, away from low ability students who are experiencing negative impact from their presence and other middle students, who are not benefitting from them anyways.

We find robust evidence that peers matter for academic achievements but the size and nature of peer effects vary tremendously by the type of peer effects (roommates or friends) in consideration and the socio-economic and demographic characteristics of the student in question.

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Table 1: Summary Statistics by Residential Halls

Variables of Interest	Overall	Hall I	Hall II	Hall III
Academic Achievement				
Current Marks	66.12	66.44	66.23	65.17
Cumulative Marks	66.32	66.04	66.64	66.16
Total Marks	66.79	66.86	66.80	66.62
Academic Index	81.28	81.08	81.25	81.80
Standard X Marks	82.64	82.46	82.40	83.62
Standard XII Marks	79.92	79.71	80.09	79.97
Individual Characteristics				
Age (in years)	20.12	20.11	20.09	20.23
Medium of Instruction English	0.27	0.27	0.28	0.25
UG program dummy	0.82	0.82	0.88	0.69
Second year dummy	0.37	0.33	0.38	0.45
Third year dummy	0.25	0.28	0.28	0.14
General category	0.78	0.78	0.78	0.76
Urban dummy	0.41	0.46	0.41	0.33
Semi-urban dummy	0.15	0.15	0.12	0.22
Rural dummy	0.44	0.39	0.48	0.45
Attends tuition dummy	0.22	0.25	0.21	0.19
Limiting Illness dummy	0.04	0.05	0.05	0.01

Current marks is marks obtained in the major subject in the last semester. Cumulative is total marks in the major subject and Overall marks includes both major, minor, English and other compulsory subjects. Backward class focuses only on SCs/STs/OBCs and the General category sees the effect only on the general category. Non-urban background includes students from both semi-urban and rural areas. English background includes students from both ICSE and CBSE backgrounds. The other background includes both Bengali, Hindi and other backgrounds.

Table 2: Test for Random Roommate Assignment

Variables of Interest	Dependent variable: Own Academic Ability			
	(1)	(2)	(3)	(4)
(Mean) Roommate's Ability				
Roommate's Academic Index	0.042 (0.026)		0.041 (0.027)	
Roommate's Standard X Marks		0.049 (0.031)		0.032 (0.034)
Roommate's Standard XII Marks		-0.011 (0.039)		0.006 (0.043)
(Mean) Friend's Ability				
Friend's Academic Index			0.004 (0.006)	
Friend's Standard X Marks				0.047 (0.038)
Friend's Standard XII Marks				-0.045 (0.040)
Constant	-1.890 (2.497)	-1.740 (2.457)	-1.936 (2.507)	-1.843 (2.474)
Observations	545	545	544	544
R-squared	0.830	0.830	0.830	0.831

The other control variables that were included in the regressions are leave me out ability, program and year fixed effects. Clustered standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 3: Peer Effects in Academic Achievement

Variables of Interest	Current	Cumulative	Overall	Current	Cumulative	Overall	Current	Cumulative	Overall
Roommate's Marks	0.203*** (0.0724)	0.222*** (0.0695)	0.300*** (0.0660)						
Own Academic Index	0.590*** (0.0924)	0.712*** (0.0838)	0.631*** (0.0664)	0.624*** (0.0882)	0.754*** (0.0792)	0.670*** (0.0689)			
Roommate's Academic Index	0.139 (0.123)	0.129 (0.119)	0.0420 (0.0889)	0.305*** (0.115)	0.345*** (0.104)	0.297*** (0.0812)			
Own Standard X Marks							0.0307 (0.0845)	0.0962 (0.0750)	0.0607 (0.0656)
Roommate's Standard X Marks							0.103 (0.139)	0.192 (0.137)	0.0574 (0.114)
Own Standard XII Marks							0.630*** (0.0957)	0.695*** (0.0862)	0.646*** (0.0814)
Roommate's Standard XII Marks							0.196 (0.155)	0.136 (0.149)	0.241* (0.131)
Observations	539	539	538	539	539	538	539	539	538
R-squared	0.193	0.259	0.326	0.175	0.238	0.277	0.194	0.257	0.308

Current marks is marks obtained in the major subject in the last semester. Cumulative is total marks in the major subject and Overall marks includes both major, minor, English and other compulsory subjects. The other control variables that were included in the regressions are age of the student (in years), medium of instruction, region of residence, caste of the student (forward or backward class), program and year fixed effects, whether attends tuition, and whether has limiting illness. Clustered standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 4: Peer Effects in Academic Achievement with location-specific fixed effects

Variables of Interest	Current	Cumulative	Overall	Current	Cumulative	Overall	Current	Cumulative	Overall
Own Academic Index	0.619*** (0.0925)	0.739*** (0.0840)	0.660*** (0.0708)	0.615*** (0.0907)	0.739*** (0.0826)	0.660*** (0.0702)	0.627*** (0.0879)	0.755*** (0.0794)	0.671*** (0.0692)
Roommate's Academic Index	0.342*** (0.117)	0.366*** (0.111)	0.305*** (0.0841)	0.323*** (0.116)	0.355*** (0.110)	0.303*** (0.0823)	0.313*** (0.115)	0.350*** (0.105)	0.301*** (0.0822)
Dorm Fixed Effects	Yes	Yes	Yes	No	No	No	No	No	No
Floor Fixed Effects	No	No	No	Yes	Yes	Yes	No	No	No
Hall Fixed Effects	No	No	No	No	No	No	Yes	Yes	Yes
Observations	539	539	538	539	539	538	539	539	538
R-squared	0.196	0.263	0.299	0.192	0.260	0.298	0.177	0.239	0.278

Current marks is marks obtained in the major subject in the last semester. Cumulative is total marks in the major subject and Overall marks includes both major, minor, English and other compulsory subjects. There are fifteen dorm fixed effects based on the wings (N/S/E/W) in different floors of the halls, nine floor fixed effects (three in each hall) and three hall fixed effects. The other control variables that were included in the regressions are age of the student (in years), medium of instruction, region of residence, caste of the student (forward or backward class), program and year fixed effects, whether attends tuition, and whether has limiting illness. Clustered standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 5: Peer Effects in Academic Achievement by Academic Index Groups

Variables of Interest	Current	Cumulative	Overall
Own Academic Index bottom 25%	-5.677*** (1.216)	-6.923*** (1.067)	-6.035*** (0.965)
Own Academic Index top 25%	6.324*** (1.493)	6.844*** (1.307)	6.777*** (0.907)
Roommate's Academic Index bottom 25%	-2.081* (1.206)	-2.203* (1.178)	-1.820* (1.023)
Roommate's Academic Index top 25%	2.474* (1.440)	2.805** (1.232)	1.988** (0.925)
Observations	539	539	538
R-squared	0.186	0.237	0.284

Current marks is marks obtained in the major subject in the last semester. Cumulative is total marks in the major subject and Overall marks includes both major, minor, English and other compulsory subjects. The other control variables that were included in the regressions are age of the student (in years), medium of instruction, region of residence, caste of the student (forward or backward class), program and year fixed effects, whether attends tuition, and whether has limiting illness. Clustered standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 6: Interaction Effects between Own and Roommate Background

Own Academic Index	Roommate Academic Index		
	Bottom 25%	Middle 50%	Top 25%
Bottom 25%	-8.096*** (1.773)	-8.246*** (1.556)	-7.051** (3.050)
Middle 50%	-2.129 (1.884)	0	1.547 (1.744)
Top 25%	-0.762 (2.683)	6.745*** (2.175)	11.01*** (1.979)

The coefficients presented in this table are the interaction effects estimated from the regression $honours = \beta_1(own = bottom, roommate = bottom) + \beta_2(own = bottom, roommate = middle) + \beta_3(own = bottom, roommate = top) + \beta_4(own = middle, roommate = bottom) + \beta_5(own = middle, roommate = top) + \beta_6(own = top, roommate = bottom) + \beta_7(own = top, roommate = middle) + \beta_8(own = top, roommate = top) + \gamma X + u$ where $(own = middle, roommate = middle)$ is the benchmark category.

The other control variables that were included in the regression are age of the student (in years), medium of instruction, region of residence, caste of the student (forward or backward class), program and year fixed effects, whether attends tuition, and whether has limiting illness. Clustered standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 7: Peer Effects in Academic Achievement by Background characteristics

Panel A	General Category			Backward classes		
	Current	Cumulative	Overall	Current	Cumulative	Overall
Own Academic Index	0.776*** (0.110)	0.881*** (0.0981)	0.811*** (0.0870)	0.186 (0.144)	0.355** (0.137)	0.221** (0.0997)
Roommate's Academic Index	0.302** (0.143)	0.329** (0.133)	0.268** (0.103)	0.315* (0.180)	0.417** (0.167)	0.369*** (0.140)
Observations	422	422	421	117	117	117
R-squared	0.204	0.255	0.303	0.132	0.247	0.300

Panel B	Urban background			Non-urban background		
	Current	Cumulative	Overall	Current	Cumulative	Overall
Own Academic Index	1.143*** (0.160)	1.157*** (0.138)	0.932*** (0.127)	0.353*** (0.103)	0.541*** (0.0939)	0.513*** (0.0741)
Roommate's Academic Index	0.320* (0.181)	0.327* (0.166)	0.253* (0.141)	0.298** (0.136)	0.350*** (0.124)	0.327*** (0.0936)
Observations	228	228	227	311	311	311
R-squared	0.289	0.314	0.343	0.148	0.219	0.258

Panel C	English Background			Other Background		
	Current	Cumulative	Overall	Current	Cumulative	Overall
Own Academic Index	1.350*** (0.195)	1.347*** (0.166)	1.035*** (0.124)	0.364*** (0.0854)	0.543*** (0.0809)	0.533*** (0.0770)
Roommate's Academic Index	0.404* (0.231)	0.373* (0.209)	0.288* (0.158)	0.310** (0.132)	0.335*** (0.122)	0.300*** (0.0989)
Observations	149	149	148	390	390	390
R-squared	0.332	0.380	0.390	0.177	0.232	0.260

Current marks is marks obtained in the major subject in the last semester. Cumulative is total marks in the major subject and Overall marks includes both major, minor, English and other compulsory subjects. Backward class focuses only on SCs/STs/OBCs and the General category sees the effect only on the general category. Non-urban background includes students from both semi-urban and rural areas. English background includes students from both ICSE and CBSE backgrounds. The other background includes both Bengali, Hindi and other backgrounds. The other control variables that were included in the regressions are age of the student (in years), medium of instruction, region of residence, caste of the student (forward or backward class), program and year fixed effects, whether attends tuition, and whether has limiting illness. Clustered standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 8: Roommate Effect by Background characteristics of the roommates

Panel A	Total Sample			Backward class Sample			General category Sample		
	Current	Cumulative	Overall	Current	Cumulative	Overall	Current	Cumulative	Overall
Own Academic Index	0.670*** (0.0912)	0.798*** (0.0819)	0.704*** (0.0727)	0.217 (0.149)	0.400*** (0.140)	0.260** (0.106)	0.825*** (0.111)	0.924*** (0.0986)	0.839*** (0.0892)
Roommate's Academic Index (General class)	0.0664 (0.0429)	0.0962** (0.0391)	0.102*** (0.0306)	0.323 (0.228)	0.532** (0.214)	0.560*** (0.151)	0.0499 (0.0453)	0.0771* (0.0410)	0.0825*** (0.0306)
Roommate's Academic Index (Backward class)	0.0186 (0.0139)	0.0186 (0.0134)	0.0200* (0.0113)	0.0117 (0.0298)	0.0337 (0.0290)	0.0408* (0.0205)	0.0180 (0.0174)	0.0155 (0.0158)	0.0162 (0.0134)
Observations	539	539	538	117	117	117	422	422	421
R-squared	0.172	0.235	0.281	0.130	0.261	0.349	0.200	0.252	0.305

Panel B	Total Sample			Non-urban background			Urban background		
	Current	Cumulative	Overall	Current	Cumulative	Overall	Current	Cumulative	Overall
Own Academic Index	0.687*** (0.0916)	0.826*** (0.0826)	0.732*** (0.0747)	0.416*** (0.106)	0.623*** (0.0960)	0.592*** (0.0793)	1.203*** (0.151)	1.220*** (0.130)	0.986*** (0.126)
Roommate's Academic Index (Urban background)	0.0133 (0.0157)	0.00624 (0.0138)	0.00709 (0.0116)	0.00639 (0.0195)	-0.00600 (0.0179)	-0.0008 (0.0139)	0.0279 (0.0244)	0.0259 (0.0222)	0.0227 (0.0197)
Roommate's Academic Index (Nonurban background)	0.0167 (0.0172)	0.0189 (0.0165)	0.0210* (0.0124)	0.00685 (0.0276)	0.0132 (0.0260)	0.0276 (0.0187)	0.0200 (0.0224)	0.0189 (0.0218)	0.00691 (0.0164)
Observations	539	539	538	311	311	311	228	228	227
R-squared	0.167	0.225	0.264	0.138	0.204	0.241	0.284	0.308	0.338

Panel C	Total Sample			Non-English background			English background		
	Current	Cumulative	Overall	Current	Cumulative	Overall	Current	Cumulative	Overall
Own Academic Index	0.691*** (0.0920)	0.829*** (0.0828)	0.734*** (0.0755)	0.426*** (0.0883)	0.610*** (0.0844)	0.592*** (0.0821)	1.404*** (0.183)	1.398*** (0.157)	1.076*** (0.121)
Roommate's Academic Index (English background)	-0.00112 (0.0145)	-0.00495 (0.0136)	-0.00935 (0.0106)	0.00782 (0.0163)	-0.00238 (0.0161)	-0.00958 (0.0128)	-0.0207 (0.0318)	-0.0154 (0.0276)	-0.0104 (0.0223)
Roommate's Academic Index (Non-English background)	0.000534 (0.0258)	0.00225 (0.0236)	0.0121 (0.0199)	0.0382 (0.0391)	0.0442 (0.0368)	0.0513* (0.0282)	-0.00659 (0.0335)	-0.00883 (0.0287)	-0.00244 (0.0265)
Observations	539	539	538	390	390	390	149	149	148
R-squared	0.165	0.224	0.263	0.168	0.221	0.253	0.323	0.370	0.380

Current marks is marks obtained in the major subject in the last semester. Cumulative is total marks in the major subject and Overall marks includes both major, minor, English and other compulsory subjects. Backward class focuses only on SCs/STs/OBCs and the General category sees the effect only on the general category. Non-urban background includes students from both semi-urban and rural areas. English background includes students from both ICSE and CBSE backgrounds. The other background includes both Bengali, Hindi and other backgrounds. The other control variables that were included in the regressions are age of the student (in years), medium of instruction, region of residence, caste of the student (forward or backward class), program and year fixed effects, whether attends tuition, and whether has limiting illness. Clustered standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 9: Falsification Test using randomly assigned non-peer group

Variables of Interest	Specification I: Linearity			Specification II: Nonlinearity		
	Current	Cumulative	Overall	Current	Cumulative	Overall
Own Academic Index	0.691*** (0.0917)	0.830*** (0.0801)	0.736*** (0.0681)			
Group's Academic Index	0.0123 (0.131)	0.0215 (0.113)	0.0803 (0.0909)			
Own Academic Index bottom 25%				-6.474*** (1.287)	-7.713*** (1.152)	-6.611*** (1.010)
Own Academic Index top 25%				6.670*** (1.349)	7.271*** (1.242)	7.103*** (0.978)
Group's Academic Index bottom 25%				-0.0482 (1.333)	-0.551 (1.205)	-1.037 (0.976)
Group's Academic Index top 25%				0.456 (1.396)	0.0697 (1.268)	0.228 (0.935)
Observations	539	539	538	539	539	538
R-squared	0.165	0.223	0.262	0.173	0.221	0.272

Current marks is marks obtained in the major subject in the last semester. Cumulative is total marks in the major subject and Overall marks includes both major, minor, English and other compulsory subjects. The other control variables that were included in the regressions are age of the student (in years), medium of instruction, region of residence, caste of the student (forward or backward class), program and year fixed effects, whether attends tuition, and whether has limiting illness. Clustered standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 10: Friendship Effects in Academic Achievement

Variables of Interest	Current	Cumulative	Overall	Current	Cumulative	Overall
Own Academic Index	0.534*** (0.104)	0.640*** (0.0943)	0.589*** (0.0722)			
Friend's Academic Index	0.570** (0.238)	0.656*** (0.212)	0.547*** (0.172)			
Own Standard X Marks				-0.00987 (0.0936)	0.0383 (0.0844)	0.0292 (0.0655)
Friend's Standard X Marks				0.177 (0.369)	0.391 (0.375)	0.0446 (0.327)
Own Standard XII Marks				0.592*** (0.109)	0.650*** (0.102)	0.606*** (0.0864)
Friend's Standard XII Marks				0.369 (0.387)	0.233 (0.389)	0.485 (0.361)
Observations	493	493	493	493	493	493
R-squared	0.155	0.211	0.260	0.182	0.228	0.306
F-stat from the First Stage Regression						
Instrumental variable 1	141.46	141.46	141.46	67.44	67.44	67.44
Instrumental variable 2				58.02	58.02	58.02

Current marks is marks obtained in the major subject in the last semester. Cumulative is total marks in the major subject and Overall marks includes both major, minor, English and other compulsory subjects. Individuals with no best friends from college were dropped out from these regressions. The other control variables that were included in the regressions are age of the student (in years), medium of instruction, region of residence, caste of the student (forward or backward class), program and year fixed effects, whether attends tuition, and whether has limiting illness. Clustered standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 11: Potential Mechanisms for Peer Effects in Academic Achievement

Variables of Interest	Current	Cumulative	Overall	Current	Cumulative	Overall
Own effort (measured in hours)						
Self-study (Total)	0.081** (0.038)	0.080** (0.038)	0.017 (0.030)			
Group-study (Total)	0.099 (0.123)	0.072 (0.108)	0.214** (0.092)			
Tuition (Total)	-0.144 (0.183)	-0.208 (0.168)	-0.149 (0.107)			
Self-study (Weekdays)				0.080 (0.085)	0.028 (0.081)	-0.013 (0.065)
Group-study (Weekdays)				0.086 (0.160)	0.099 (0.138)	0.204* (0.114)
Tuition (Weekdays)				-0.151 (0.185)	-0.206 (0.168)	-0.139 (0.111)
Self-study (Weekends)				0.069 (0.154)	0.167 (0.144)	0.068 (0.110)
Group-study (Weekends)				0.231 (0.452)	-0.015 (0.433)	0.333 (0.332)
Tuition (Weekends)				0.528 (0.477)	0.426 (0.452)	0.060 (0.342)
Roommate's effort (measured in hours)						
Self-study (Total)	-0.002 (0.048)	-0.008 (0.050)	-0.039 (0.042)			
Group-study (Total)	0.367** (0.180)	0.435** (0.176)	0.488*** (0.139)			
Tuition (Total)	0.153 (0.180)	0.164 (0.181)	0.169 (0.158)			
Self-study (Weekdays)				0.026 (0.150)	-0.021 (0.147)	-0.012 (0.125)
Group-study (Weekdays)				0.399* (0.215)	0.468** (0.216)	0.555*** (0.169)
Tuition (Weekdays)				0.005 (0.209)	0.057 (0.217)	0.047 (0.177)
Self-study (Weekends)				-0.100 (0.263)	-0.027 (0.248)	-0.128 (0.207)
Group-study (Weekends)				0.206 (0.634)	0.383 (0.655)	0.075 (0.600)
Tuition (Weekends)				1.528** (0.724)	1.379** (0.697)	1.307** (0.553)
Observations	539	539	538	539	539	538
R-squared	0.091	0.100	0.125	0.101	0.109	0.135

Current marks is marks obtained in the major subject in the last semester. Cumulative is total marks in the major subject and Overall marks includes both major, minor, English and other compulsory subjects. Individuals with no best friends from college were dropped out from these regressions. The other control variables that were included in the regressions are age of the student (in years), medium of instruction, region of residence, caste of the student (forward or backward class), program and year fixed effects, whether attends tuition, and whether has limiting illness. Clustered standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 12: Other Potential Mechanisms for Peer Effects in Academic Achievement

Variables of Interest	Current	Cumulative	Overall	Current	Cumulative	Overall
Own effort (measured in hours)						
Self-study (Total)	0.078** (0.036)	0.077** (0.036)	0.015 (0.028)	0.077** (0.037)	0.078** (0.037)	0.014 (0.030)
Group-study (Total)	0.068 (0.121)	0.038 (0.106)	0.186** (0.090)	0.082 (0.124)	0.058 (0.109)	0.197** (0.092)
Tuition (Total)	-0.128 (0.194)	-0.191 (0.179)	-0.136 (0.112)	-0.147 (0.185)	-0.213 (0.171)	-0.155 (0.109)
Roommate's effort (measured in hours)						
Self-study (Total)	-0.001 (0.048)	-0.007 (0.048)	-0.040 (0.041)	0.002 (0.048)	-0.005 (0.050)	-0.036 (0.041)
Group-study (Total)	0.322* (0.182)	0.383** (0.178)	0.437*** (0.138)	0.361** (0.179)	0.421** (0.176)	0.475*** (0.137)
Tuition (Total)	0.182 (0.180)	0.196 (0.180)	0.198 (0.165)	0.153 (0.178)	0.165 (0.179)	0.170 (0.157)
Other Possible Channels (Own)						
Life satisfaction	0.942*** (0.359)	1.029*** (0.342)	0.815*** (0.246)			
Self-Assessed Health				1.275** (0.612)	1.011* (0.606)	1.215** (0.493)
Other Possible Channels (Roommate's)						
Life satisfaction	0.969* (0.541)	1.102** (0.535)	1.171** (0.451)			
Self-Assessed Health				0.012 (1.431)	0.605 (1.401)	0.561 (1.133)
Observations	539	539	538	539	539	538
R-squared	0.111	0.126	0.158	0.096	0.104	0.134

Current marks is marks obtained in the major subject in the last semester. Cumulative is total marks in the major subject and Overall marks includes both major, minor, English and other compulsory subjects. Individuals with no best friends from college were dropped out from these regressions. The other control variables that were included in the regressions are age of the student (in years), medium of instruction, region of residence, caste of the student (forward or backward class), program and year fixed effects, whether attends tuition, and whether has limiting illness. Life satisfaction is the response of the student to the question: "All things considered, how satisfied are you with your life? Pick a number between 0 and 10 to indicate how satisfied you are. Enter number from 0 to 10". The Self-Assessed Health variable records their response to "In general, would you say your health is: 1 "excellent", 2 "very good", 3 "good" 4 "fair" 5 "poor". These responses have been rescaled so that 5 refers to "excellent" and 1 "poor". Clustered standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Figure 1: Map of the Residential complex

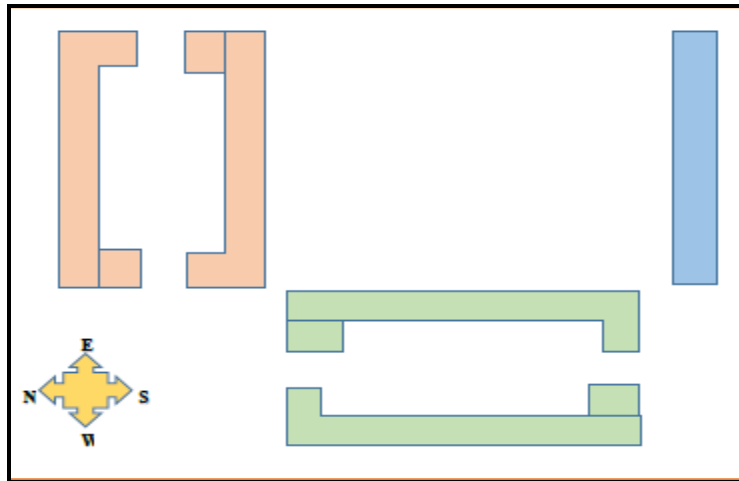


Figure 2: Academic Achievement by different castes

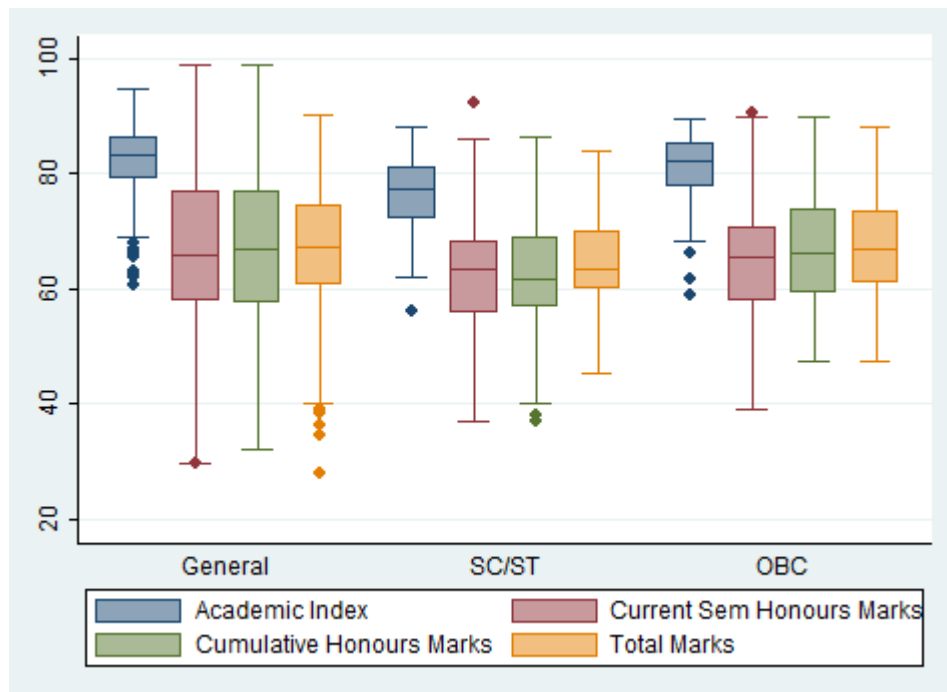


Figure 3: Academic Achievement by region of residence

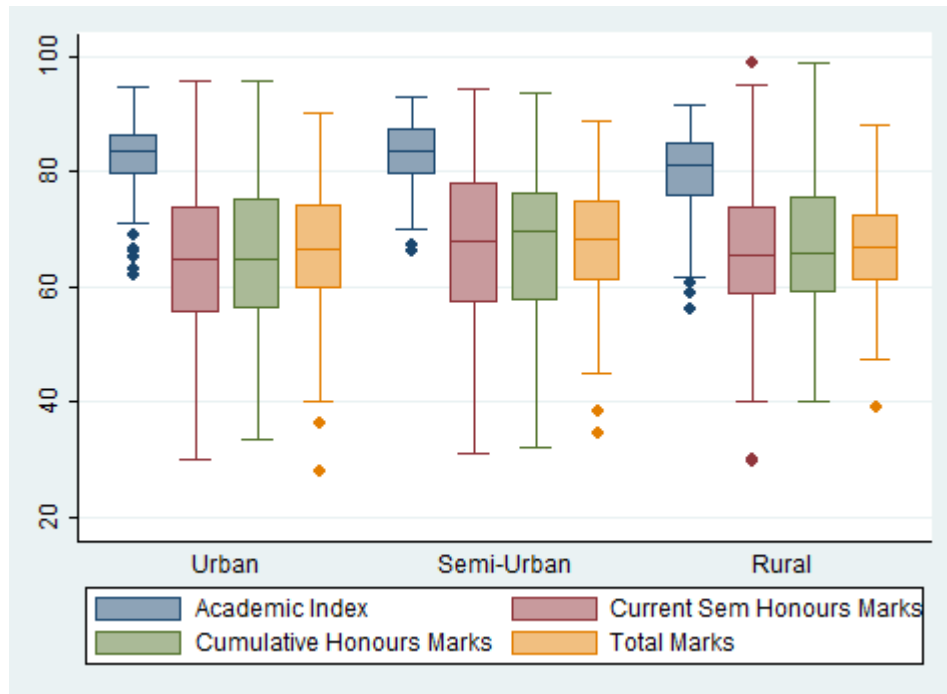


Figure 4: Academic Achievement by medium of instruction

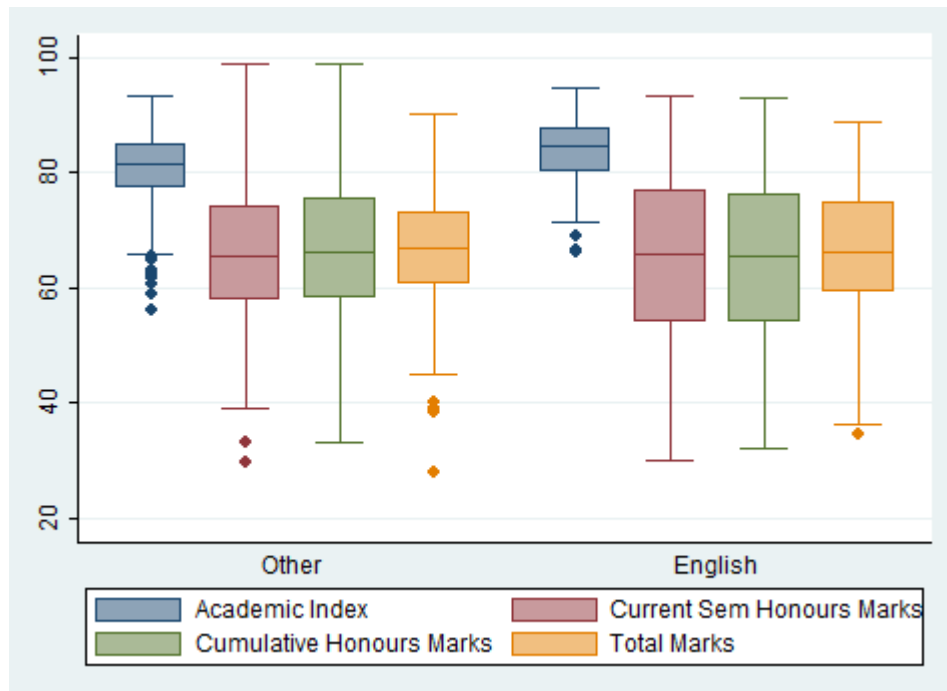
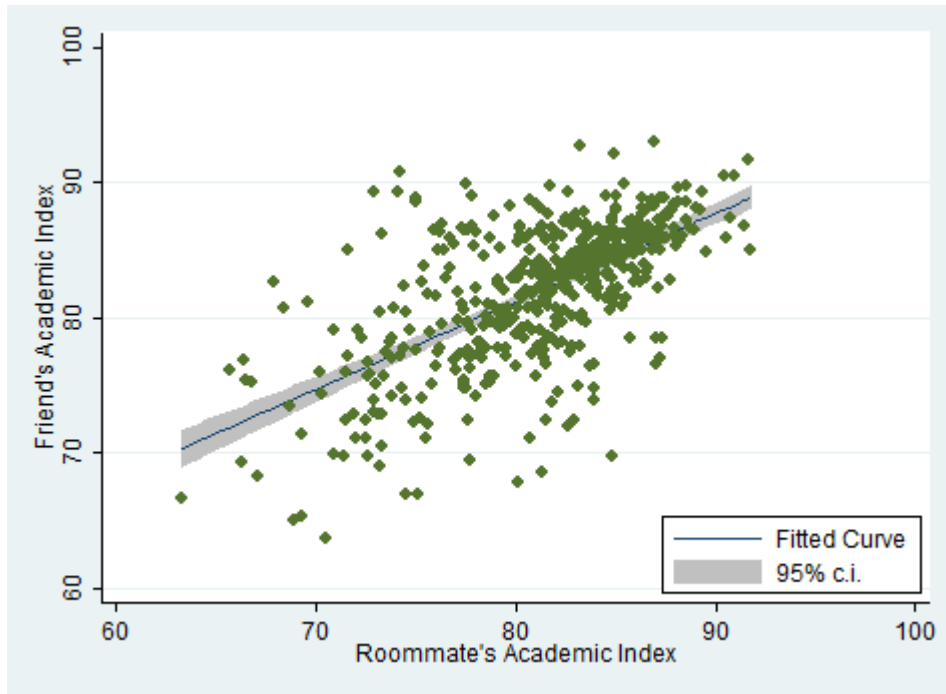


Figure 5: Estimated linear relationship between peer Academic Index



Appendix A

Appendix Table A: Full set of Regressions Results for Academic Achievements

Variables of Interest	Current	Cumulative	Overall
Own Academic Index	0.624*** (0.0882)	0.754*** (0.0792)	0.670*** (0.0689)
Roommate's Academic Index	0.305*** (0.115)	0.345*** (0.104)	0.297*** (0.0812)
Age (in years)	-0.649 (0.604)	-0.950* (0.546)	-0.896** (0.417)
Medium of Instruction English	-2.280* (1.244)	-2.244** (1.133)	-1.691* (0.908)
Semi-urban dummy	1.636 (1.734)	1.018 (1.603)	-0.427 (1.177)
Rural dummy	3.220*** (1.198)	3.524*** (1.050)	1.048 (0.878)
SC dummy	-0.480 (1.601)	-0.638 (1.482)	1.209 (1.134)
ST dummy	-8.916 (7.181)	-9.791 (6.832)	-0.844 (4.515)
OBC dummy	-1.042 (1.527)	0.0882 (1.428)	0.685 (1.150)
UG degree dummy	-1.292 (2.412)	-4.603* (2.335)	-1.348 (2.113)
Second year dummy	-1.813 (1.489)	-0.186 (1.419)	5.246*** (1.219)
Third year dummy	3.303 (1.996)	4.114** (1.727)	3.993*** (1.302)
Attends tuition dummy	0.0752 (1.375)	1.140 (1.258)	0.224 (0.953)
Limiting Illness dummy	0.115 (2.625)	0.298 (2.369)	0.951 (1.632)
Constant	3.605 (18.33)	-2.330 (16.36)	4.018 (13.99)
Observations	539	539	538
R-squared	0.175	0.238	0.277

Current marks is marks obtained in the major subject in the last semester. Cumulative is total marks in the major subject and Overall marks includes both major, minor, English and other compulsory subjects. Clustered standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Appendix Table B1: Robustness Checks for Tests of Random Roommate Assignment

Dependent variable: Own Academic Ability						
Variables of Interest	(1)	(2)	(3)	(4)	(5)	(6)
(Mean) Roommate's Ability						
Roommate's Academic Index	0.037 (0.028)	0.042 (0.026)	0.043 (0.026)	0.035 (0.028)	0.041 (0.026)	0.041 (0.027)
(Mean) Friend's Ability						
Friend's Academic Index				0.004 (0.006)	0.004 (0.006)	0.004 (0.006)
Constant	-1.910 (2.569)	-2.380 (2.586)	-1.921 (2.527)	-1.958 (2.569)	-2.418 (2.597)	-1.959 (2.536)
Dorm Fixed Effects	Yes	No	No	Yes	No	No
Floor Fixed Effects	No	Yes	No	No	Yes	No
Hall Fixed Effects	No	No	Yes	No	No	Yes
Observations	545	545	545	544	544	544
R-squared	0.833	0.832	0.830	0.833	0.832	0.830

There are fifteen dorm fixed effects based on the wings (N/S/E/W) in different floors of the halls, nine floor fixed effects (three in each hall) and three hall fixed effects. The other control variables that were included in the regressions are leave me out ability, program and year fixed effects. Clustered standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Appendix Table B2: Robustness Checks for Tests of Random Roommate Assignment

Variables of Interest	Dependent variable: Own Academic Ability		
	(1)	(2)	(3)
(Mean) Roommate's Ability			
Roommate's Academic Index (General class)	-0.006 (0.012)		
Roommate's Academic Index (Backward class)	-0.002 (0.003)		
Roommate's Academic Index (Urban background)		-0.001 (0.004)	
Roommate's Academic Index (Nonurban background)		-0.004 (0.004)	
Roommate's Academic Index (English background)			0.004 (0.003)
Roommate's Academic Index (Non-English background)			-0.004 (0.006)
Constant	0.968 (2.506)	0.806 (2.496)	0.759 (2.527)
Observations	545	545	545
R-squared	0.830	0.829	0.830

The other control variables that were included in the regressions are leave me out ability, program and year fixed effects. Clustered standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Appendix Table C: Heterogeneous impact of peer abilities

Variables of Interest	Low abled individuals			High abled individuals		
	Current	Cumulative	Overall	Current	Cumulative	Overall
Own Academic Index	0.209* (0.111)	0.321*** (0.107)	0.322*** (0.103)	0.947*** (0.304)	1.086*** (0.269)	1.082*** (0.190)
Roommate's Academic Index	0.199 (0.143)	0.271** (0.133)	0.237* (0.127)	0.404** (0.170)	0.367** (0.151)	0.346*** (0.101)
Observations	225	225	224	314	314	314
R-squared	0.203	0.222	0.181	0.115	0.129	0.200

Current marks is marks obtained in the major subject in the last semester. Cumulative is total marks in the major subject and Overall marks includes both major, minor, English and other compulsory subjects. The other control variables that were included in the regressions are age of the student (in years), medium of instruction, region of residence, caste of the student (forward or backward class), program and year fixed effects, whether attends tuition, and whether has limiting illness. Clustered standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Appendix Table D: Robustness Results for the Urban v/s Non-urban Peer Effects

Panel A	Non-Metro Residents			Metro Residents		
	Current	Cumulative	Overall	Current	Cumulative	Overall
Own Academic Index	0.494*** (0.0983)	0.674*** (0.0887)	0.600*** (0.0673)	1.178*** (0.212)	1.121*** (0.177)	0.967*** (0.174)
Roommate's Academic Index	0.352*** (0.119)	0.400*** (0.109)	0.306*** (0.0857)	0.0982 (0.260)	0.121 (0.238)	0.228 (0.199)
Observations	412	412	412	127	127	126
R-squared	0.156	0.230	0.262	0.284	0.299	0.353

Panel B	Rural Background			Non-rural Background		
	Current	Cumulative	Overall	Current	Cumulative	Overall
Own Academic Index	0.386*** (0.102)	0.552*** (0.0924)	0.485*** (0.0761)	0.909*** (0.142)	0.983*** (0.130)	0.859*** (0.123)
Roommate's Academic Index	0.285* (0.167)	0.335** (0.150)	0.321*** (0.0967)	0.284* (0.164)	0.305** (0.153)	0.248* (0.129)
Observations	232	232	232	307	307	306
R-squared	0.188	0.274	0.292	0.202	0.241	0.302

Current marks is marks obtained in the major subject in the last semester. Cumulative is total marks in the major subject and Overall marks includes both major, minor, English and other compulsory subjects. The other control variables that were included in the regressions are age of the student (in years), medium of instruction, region of residence, caste of the student (forward or backward class), program and year fixed effects, whether attends tuition, and whether has limiting illness. Metro residents are students from the city and district of Kolkata whereas the residents of other districts are Non-metro residents. Students from urban and semi-urban regions are counted as residents from Non-rural background. Clustered standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Appendix Table E: Robustness Results for the Urban v/s Non-urban Peer Effects

Panel A	Total Sample			Non-Metro Residents			Metro Residents		
	Current	Cumulative	Overall	Current	Cumulative	Overall	Current	Cumulative	Overall
Own Academic Index	0.691*** (0.092)	0.828*** (0.083)	0.735*** (0.076)	0.564*** (0.100)	0.750*** (0.092)	0.658*** (0.071)	1.215*** (0.205)	1.170*** (0.170)	1.042*** (0.176)
Roommate's Academic Index (Metro Residents)	0.003 (0.013)	-0.001 (0.012)	0.006 (0.009)	-0.010 (0.016)	-0.020 (0.015)	-0.013 (0.011)	0.034 (0.028)	0.048* (0.026)	0.062*** (0.022)
Roommate's Academic Index (Non-Metro Residents)	0.009 (0.038)	0.015 (0.036)	0.027 (0.029)	0.015 (0.042)	0.020 (0.038)	0.026 (0.032)	-0.055 (0.047)	-0.063 (0.047)	-0.010 (0.040)
Observations	539	539	538	412	412	412	127	127	126
R-squared	0.165	0.224	0.263	0.143	0.216	0.249	0.295	0.322	0.392

Panel B	Total Sample			Rural Background			Non-rural Background		
	Current	Cumulative	Overall	Current	Cumulative	Overall	Current	Cumulative	Overall
Own Academic Index	0.687*** (0.0922)	0.828*** (0.0826)	0.738*** (0.0749)	0.444*** (0.109)	0.623*** (0.0947)	0.558*** (0.0805)	0.993*** (0.135)	1.072*** (0.126)	0.936*** (0.122)
Roommate's Academic Index (Rural Background)	-0.023 (0.017)	-0.018 (0.015)	-0.021* (0.012)	0.039 (0.025)	0.033 (0.022)	0.026 (0.018)	-0.057** (0.024)	-0.049** (0.022)	-0.051*** (0.016)
Roommate's Academic Index (Non-rural Background)	0.010 (0.021)	0.001 (0.018)	-0.008 (0.014)	0.025 (0.028)	0.017 (0.024)	0.004 (0.018)	0.006 (0.032)	-0.006 (0.029)	-0.009 (0.020)
Observations	539	539	538	232	232	232	307	307	306
R-squared	0.170	0.226	0.266	0.190	0.266	0.275	0.217	0.248	0.318

Current marks is marks obtained in the major subject in the last semester. Cumulative is total marks in the major subject and Overall marks includes both major, minor, English and other compulsory subjects. The other control variables that were included in the regressions are age of the student (in years), medium of instruction, region of residence, caste of the student (forward or backward class), program and year fixed effects, whether attends tuition, and whether has limiting illness. Metro residents are students from the city and district of Kolkata whereas the residents of other districts are Non-metro residents. Students from urban and semi-urban regions are counted as residents from Non-rural background. Clustered standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Appendix Table F: Having Roommates as Friends

Dependent variable: Friendship Nominations			
Variables of Interest	(1)	(2)	(3)
Age (in years)	-0.025 (0.027)	-0.022 (0.027)	-0.019 (0.027)
Medium of Instruction English	-0.086* (0.051)	-0.082 (0.051)	-0.074 (0.051)
Backward class	0.089* (0.051)	0.084* (0.051)	0.080 (0.051)
Urban region dummy	-0.000 (0.046)	-0.000 (0.046)	0.012 (0.047)
Limiting Illness dummy	0.198* (0.102)	0.197* (0.102)	0.202** (0.101)
Risk Index		-0.018 (0.011)	-0.019* (0.011)
Body Mass Index (BMI)			-0.009* (0.005)
Constant	1.059* (0.583)	1.088* (0.582)	1.237** (0.588)
Observations	544	544	544
R-squared	0.043	0.047	0.052

The other control variables that were included in the regressions are program and year fixed effects. Clustered standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Risk index is on a scale of 0 to 10 and is the response of the students to the following question “Generally, some people prefer to take risk, while others try to avoid any risk. If it is to rank the risk from low to high as 0 to 10 (as shown by the following chart), 0 is “never take risk”, 10 is “most likely to take risk”, which level do you belong to? (Choose a number from 0 to 10)”. Body Mass Index is measured as weight (in kg)/height (in metre) squared.

Appendix Table G: Robustness Check for Peer Effects with Initial Roommate Assignment

Variables of Interest	Current	Cumulative	Overall	Current	Cumulative	Overall	Current	Cumulative	Overall
Roommate's Marks	0.143 (0.0930)	0.167* (0.0847)	0.243*** (0.0785)						
Own Academic Index	0.595*** (0.0921)	0.708*** (0.0850)	0.619*** (0.0692)	0.619*** (0.0873)	0.742*** (0.0790)	0.661*** (0.0694)			
Roommate's Academic Index	0.164 (0.144)	0.165 (0.139)	0.0698 (0.0985)	0.287** (0.114)	0.330*** (0.110)	0.276*** (0.0900)			
Own Standard X Marks							0.0475 (0.0850)	0.109 (0.0798)	0.0673 (0.0687)
Roommate's Standard X Marks							0.228 (0.148)	0.244* (0.147)	0.0901 (0.123)
Own Standard XII Marks							0.617*** (0.100)	0.678*** (0.0891)	0.633*** (0.0884)
Roommate's Standard XII Marks							0.0108 (0.151)	0.0385 (0.145)	0.152 (0.132)
Observations	524	524	523	524	524	523	524	524	523
R-squared	0.181	0.246	0.301	0.172	0.235	0.274	0.189	0.253	0.301

Current marks is marks obtained in the major subject in the last semester. Cumulative is total marks in the major subject and Overall marks includes both major, minor, English and other compulsory subjects. The other control variables that were included in the regressions are age of the student (in years), medium of instruction, region of residence, caste of the student (forward or backward class), program and year fixed effects, whether attends tuition, and whether has limiting illness. Clustered standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1