Recognizing Performance

How Awards Affect Winners' and Peers' Performance in Brazil

Diana Moreira [*]

April 26, 2017

JOB MARKET PAPER

Please click here for the most recent version.

Abstract

Does the recognition of someone's accomplishment spill over to others? Awards that confer public recognition for outstanding performance can impact ex-post behavior by changing beliefs, norms or interests. I investigate whether the public recognition of students' accomplishments impacts their own and their peers' subsequent academic performance. I exploit Brazil's Math Olympiad "Honorable Mention" award which recognizes the top 4% of participants in a national competition involving 18 million students annually. I take advantage of the fact that no information is disclosed on the performance of those who do not win an award to recover the informational impact of someone's recognition. Specifically, I use a regression discontinuity design comparing classrooms with narrow winners and losers of the award. I find that the award improves the future educational outcomes of both the winner and her classmates. The spillovers on classmates are economically meaningful - one-fifth of the magnitude of the effects on the winner themselves - and have long-run consequences: the enrollment in selective colleges of classmates of a narrow award winner increases by 10%. Proximity to the winner, both physical and in terms of ability, appears to be a key mediating channel: spillovers are largest for classmates in the top quartile of the test score distribution, and depend upon the presence of the winner in the classroom. The results show that ex-post motivation and effort can be enhanced by recognizing the performance of a high-achieving student.

[*]Department of Economics and Harvard Business School, Harvard University. Email: dmoreira@fas.harvard.edu.
I'm deeply indebted to my advisors Lawrence Katz, Roland Fryer, Edward Glaeser and Gautam Rao. I would also like to thank Raj Chetty, Asim Khwaja, Mitra Akhtari, Nicolas Caramp, Alan Moreira, Ajax Moreira, Michael Kremer, Nathan Nunn, David Cutler, Francisco Soares, Claudio Ferraz, Joao Paulo Pessoa, Camila Barbosa Curi, Gulherme Lambais, Paulo Costa, Heather Sarsons, Raissa Fabregas, Jeff Picel, Jack Willis, Gilherme Lichand, Siddarth George, Rohini Pande, Martin Rotemberg, and participants of the Harvard Development lunch, the Public Finance and Labor Economic Lunch, participants in presentations at INEP and IMPA/OBMEP for numerous helpful comments. Guilherme Lambais and Pedro Henrique Cevallos provided outstanding research assistance. This paper would not have been possible without the great opportunity to collaborate with the following institutions and their staff: IMPA/OBMEP, INEP and SEEDUC/SP. I'm thankful to all the staff that made this project possible. Specifically, I'm extremely grateful to Francisco Soares, Eduardo Sao Paulo and Marcela Laureano, from INEP, Monica Souza, Claudio Landim and Luiz Lucio Renovato, from IMPA/OBMEP; Cyntia Silva and Olavo Filho, from SEEDUC/SP for outstanding collaboration. Research support from LEAP is gratefully acknowledged.

We think that recognizing ordinary people who performed extraordinary acts of kindness and service is the best way anyone can think of to promote those values and to make everyone who watches think, "I could be that person too. I could do those kinds of things too"

– Ron Rand, *President of the Congressional Medal of Honor Foundation*

1 Introduction

Recognizing performance is a ubiquitous part of economic life. In education, it often takes the form of prizes and certificates, while in the labor market, 37% of US jobs have some form of pay for performance.[1] Much research has examined how the recognition affects the recognized individual.[2] However, as the president of the Congressional Medal of Honor foundation puts it in the opening quote, the recognition of an accomplishment is often intended to influence a broader audience. Does the recognition of someone's accomplishments also affect the much larger group of individuals who witness the success? Several ideas —ranging from aspiration theory to role model and morale effects —predict that the recognition of an individual's accomplishments spills over to the performance of the peers either positively or negatively (Chung, 2000, Ray, 2006, Lazear, 1989). Yet the magnitude and scope of such spillovers remain largely unknown.

In this essay, I study these spillovers in the context of education. I investigate how the public recognition of students' accomplishments impacts their own and their classmates' subsequent academic performance. To do so, I exploit a natural experiment on performance recognition provided by a large national math competition in Brazil. My setting is well suited to studying this question because I can measure individual-level performance and because there is a well-defined social group—a classroom of students—that witnesses the award.

Specifically, I study the Honorable Mention award in Brazil's Math Olympiad. The Math Olympiad (MO) is a large annual competition, involving 89% of Brazil's public schools. The Honorable Mention is awarded to the top 4% of participants—approximately 30,000 students out of 800,000 per year. The award has two important conceptual features for the question of interest.

[1] Using Panel Study of Income Dynamics (PSID), Lemieux, McCleod and Parent (2009) estimate that the incidence of performance pay jobs is 37% on average between 1976-1998

[2] A few examples documenting ex-ante consequences are Angrist and Lavy (2009) and Kremer, Miguel, and Thornton (2009). Diamond and Persson (2016) and Dee, Dobbie, Jacob, and Rockoff (2016) examine ex-post consequences. For a comprehensive recent survey of the literature in education see Fryer (2016)

First, there is no monetary prize, only a certificate. Second, it is a public recognition. Award winners' names are disclosed on the Math Olympiad website, and school staff enters the classrooms to announce the winner.

I combine multiple sources of administrative data to track students and their classmates nationwide. I use administrative data on classroom assignments of all K-12 schools in Brazil to identify the participants' classmates at the time of the award. I then track the performance of the participants and their classmates in future years regardless of their future schools or classroom assignments. To assess the consequences for students at different parts of the ability distribution, I use several measures of academic performance, including subsequent participation in the Math Olympiad itself, school dropout data and test scores, and Brazilian SAT scores and college enrollment.

To recover the parameter of interest, I exploit a regression discontinuity design and a unique feature of my setting. The ideal experiment requires observing two equally accomplished students, only one of whom gets recognized; my empirical design approximates this.[3] Specifically, I compare two classrooms, in each of which a participant in the Math Olympiad scored close to the award threshold—one narrowly winning, the other narrowly losing. The unique feature of the setting is that the Math Olympiad organizers do not disclose the rank or score of non-winners, so near-winners don't know they were close to winning. The comparison between a comparable winner and non-winner allows me to recover the informational impact of recognition, which is a potential channel through which the recognition spills over to others.

Using data on five million students in 170,000 classrooms in schools all over Brazil, I show that the award increases the recognized students' and their classmates' subsequent academic performance. I divide the analysis into three parts. First, I find positive and meaningful spillover to the winners' classmates. The award increases participation and scores in the Math Olympiad and has long-term consequences, as it increases the classmates' enrollment in selective colleges by around 10%. To make a rough estimate of the impact on student's future earnings, I combine this causal impact of the award with non-causal estimates of the college wage premium in Brazil. The impact of the award on college enrollment is equivalent to an increase in the average classmate's

[3] If, instead, I compare all recognized and non-recognized students, regardless of whether they were equally accomplished, subsequent performance differences might be a result of pre-award differences in performance rather than the causal impact of the award (Lee and Lemieux, 2010).

annual earnings of about 39 reales (2005 CPI), 0.5% of per capita income in Brazil.[4] Since the winner has, on average, 30 classmates, the aggregate effect of the spillover is substantial. For each award given, the overall increase in classmates' annual earnings is 1170 reales. This is equivalent to expanding the conditional cash transfer in Brazil to one additional beneficiary.[5]

Second, I find that the spillovers on classmates' performance are smaller and less persistent than the impact on the winner. The increase in classmates' subsequent Math Olympiad performance is about 1/5 of the impact on the winner. Moreover, the effect on classmates lasts for one year, while for the winner the impact persists for at least two years. The differences in magnitude and persistence suggest that the mechanisms that explain the spillovers are a subset of those that explain the impact on the winner.

In the third step, I shed light on the mechanism by investigating whether dimensions of proximity to the winner matter for the classmates' performance improvement. Physical proximity is one that does. I provide evidence that the winner's continued presence in the classroom is a key mediating factor driving the spillover results: grade-mates from other classrooms do not experience a performance improvement. The award also affects the likelihood that a classmate of a participant—that is, of a winner or narrow loser—will continue to be in the same classroom as that participant, with a larger spillover on performances when that happens (although noisily estimated). While this is consistent with changes in teachers' and participant' behavior, I find evidence suggestive that at least in part the spillovers are driven by classmates' behavioral response. Specifically, I find that classmates experience a performance improvement even when they are no longer in the winner's classroom in the subsequent year. Moreover, similarity in terms of ability between the winner and the classmates also matters. The spillovers are found for students in the top quartile of the pre-award test-score distribution and on outcomes particularly relevant to those students, such better performance in the Math Olympiad and on the Brazilian SAT and greater enrollment in selective colleges. The validity of my interpretation depends on whether alternative mechanisms can account for my findings equally well. I do not, however, find support for alternative explanations. In particular, I show that the award does not affect the quality of

[4] College wage premium and other relevant statistics come from Ferreira, Firpo, and Messina (2014) and Binelli, Meghir, and Menezes-Filho (2008). Section 5 describes in detail the assumptions made, relevant statistics used and caveats with this exercise.

[5] 1170 reales represents around 15% of per capita income in Brazil

teachers or students who are assigned to the subsequent classroom of the winner.

Several countries use awards to recognize student achievement.[6] Past literature has documented several benefits of such policies, such as an improvement in educational outcomes prior to the award (Kremer et al., 2009) and benefits that accrue to the recognized student (Ebenstein, Lavy and Roth, 2017). Taken together, my results suggest that recognizing a particular student's high performance enhances effort by shaping students' perceptions of themselves (changing their perceptions about ability, goals within reach and interests), which promotes a high-performance mindset among high achievers, highlighting an additional benefit from environments that recognize performance.

This finding alters the cost-benefit calculus of the Math Olympiad program and potentially of similar tournaments. I estimate that the recognized individual experiences only 50% of the total performance improvement that the award generates, while the remaining 50% occurs among high-achieving peers.[7] Moreover, the scope of the spillovers on the peers' performance suggests the importance of certain details in the design of tournaments. In particular, the benefits occur mostly to peers in the winner's vicinity (in terms of ability and presence in the winner's classroom). One implication is that the organizational structure matters; the partition of students into classrooms and the density of classmates around the participants' level of ability matter for the spillover results.[8]

This essay relates to two bodies of work. First, it relates to a literature that studies tournaments and non-monetary rewards. Past work has documented the consequences of recognition for the performance of the recognized individual in a variety of settings —in education (Diamond and Persson, 2016), in the workplace (Neckerman, Frey and Cueni, 2014) and in on-line platforms (Gallus, 2016). I complement this literature by showing that public recognition increases performance also for the high-achieving peers for whom the "certificate effect" is absent (i.e., peers

[6]For instance, Colombia, India, Kenya, the United States, and others have introduced policies that allocate vouchers for secondary school and college and other non-monetary awards based on student achievement.

[7]This estimate is based on the impact on the Math Olympiad Performance in the subsequent year

[8]The analysis, however, is not sufficient to answer the question of whether to increase the number of awards. The degree to which marginal increases in the number of awards will improve students' overall outcomes, therefore, hinges either on information frictions or on relative concerns driving students' effort. The resulting trade-offs of an additional award in each of these cases are very different. In the information friction case, the trade-off is between motivating the top vs. discouraging the bottom. In the relative concerns case, it is between motivating the marginal and harming the infra-marginal, as the motivational value of the award is given by its scarcity. Moreover, due to the regression discontinuity design, the results should be interpreted as a net increase in the performance of peers of winners relative to peers of losers. It is possible that the results are driven by a decrease in the performance of the losers' peers.

cannot use the award as a signal to others of their ability)[9]

Second, my work contributes to research that lies at the intersection of peer effects and role models. There is a very active literature documenting the importance of peer effects in schooling behavior (Fryer and Torelli (2010); Lyle (2007); Scott E. Carrell (2009); Austen-Smith and Fryer (2005); Sacerdote (2001)). Few papers, however, look at how policies that target a particular student interact with peer effects. Two exceptions in this literature, and those most closely related to my results, are Bursztyn and Jensen (2015) and Sequeira, Spinnewijn, and Xu (2016). Both, as I do, examine the consequences of public recognition of a student's performance on her peers' performance. I complement previous findings by studying a setting where key elements of a role model effect are present—recognition happens in a group setting and is informative about goals within reach—which leads to a distinct result: public recognition has positive consequences for the peers' performance.

Specifically, Sequeira et al. (2016) study a merit scholarship in India. The authors find that the award increases a winner's perceived return to schooling, but doesn't impact her peers' perceived returns, only their self-reported interests. In contrast, I focus on actual academic achievement and behavior as outcomes and find that the award has positive effects. Differences in our results may be driven by the fact that I study effects on peers in a natural group setting (170 thousand classrooms with 5 million classmate peers), while they study a total of 1000 peers from anywhere in the winners' networks. Bursztyn and Jensen (2015) study peers in a natural group setting, a classroom. The authors shows how public recognition of students—specifically, showing the top-performing students' names on a leaderboard—backfires and discourages effort. While my results are not in contrast with theirs, as they study the ex-ante effect of recognition, their findings do suggest that in low-study cultures, a student's success can cause social sanctions and decrease peers' performance. One conceptual difference is that Bursztyn and Jensen study the effect of revealing the relative positions of students within a small group (remedial education students), an innately zero-sum action, while I study the effect of recognizing success within a larger group (nationwide). In my setting, the award reveals information about a type of goal that is within

[9]One possibility is that the award changes the reputation of the school, resulting in a "certificate effect" for the entire school. I show, however, that the benefits are exclusive to the winner's classmates, not experienced by students in other classrooms in the same grade, which goes against the school reputation explanation of the results.

students' reach.[10]

The remainder of the paper is organized as follows. Section 1.2 describes the Math Olympiad and its relation to the educational system in Brazil. Section 1.3 presents the several data sources used for the analysis. Section 1.4 outlines the empirical strategy and identification assumptions. Section 1.5 presents the results. Section 1.6 presents robustness checks. In section 1.7, I assess alternative mechanisms to explain my findings, state some limitations of my results, and discuss the policy implications of my study. Section 1.8 concludes.

2 Institutional Context

This section describes the Honorable Mention Award and how it relates to schools and classrooms in Brazil. I emphasize the aspects of the award and its context that affect the two channels through which the success of a student may affect the student and her peers: encouragement to teachers and students and an increase in school inputs provided to the classroom (Resources). In the Appendix A.3 I provide a conceptual framework which defines each of the channels. I emphasize how the context relates to each of these channels because the encouragement channel is what I claim explains the results, while the change in inputs to the classroom is the alternative explanation.

The Brazilian Math Olympiad in Public Schools (Math Olympiad) is a large annual competition that targets public schools exclusively. It is organized by *the Institute of Applied and Pure Mathematics (IMPA)*, a Brazilian federal government research institute. All public schools in Brazil that serve 6^{th} to 12^{th} grade are eligible to participate[11]. The students compete in three different levels depending on their grade: 6th-7th graders, 8th-9th graders and 10th-12th graders. Roughly 89% of the 65,000 eligible schools participate. Every year there are around 18 million student participants. The competition is advertised on popular TV channels and in every public school.

The competition is organized in two phases. The first phase is implemented entirely at the school level. The Math Olympiad organizers send each school the exam and instructions on how to grade it. [12]. The schoolteachers grade all the exams and send a list of the top 5% of students

[10] My setting may also be a high-study culture relative to that of Bursztyn and Jensen. However, 10% of the classrooms in my sample are in schools in the bottom quartile of the national distribution of public schools.

[11] There is another, much smaller Math Olympiad that is open to private schools.

[12] The school chooses a regular school day and administers the exam to all enrolled students. The share of students

in their school to the Math Olympiad organizers. The scores and ranks in this phase serve only to determine the students who qualify for the second phase. Every year around 800,000 students advance to the second phase. The prizes and awards are entirely determined by the second phase of the Math Olympiad.

The second phase is jointly implemented by a regional coordinator and the central agency.[13] The exams are graded at the regional center and then sent to the national office. The national office produces the national ranking based only on the scores of the students in the second phase of the Math Olympiad. They then assign medals (gold, bronze and silver) to the top 2,300 students and honorable mention to the subsequent 30,000 students[14].

The award used throughout this paper is the Honorable Mention award, which has three components. First, the student receives a certificate congratulating him on the accomplishment. No monetary prize or training is provided to the Honorable Mention winners. This is important because it attenuates a potential resource channel that often comes with awards that directly impact students' performance. Second, the winners' names are disclosed on the Math Olympiad website, ordered by rank. As I mentioned, non-winners get no information about their score or rank. This implies that an important component of the award is the information treatment. By winning the award, students are informed that they are in the top 4% of the participants in the 2nd phase of the Math Olympiad.[15] It is important to emphasize that the pool of 2nd phase participants is a sample that roughly consists of the top 5% of students from each public school in the country. Therefore, the award is a unique source of information about the students' positions in the national distribution, as students don't usually participate in national exams until they are about to graduate from

who participate varies by school. Based on field interviews, there are two types of schools: schools that enroll all students in the MO, reserving half of a school day for the exam, and schools that enroll certain classrooms and not others.

[13] The regional coordinator takes care of the exam implementation and part of the grading. There is approximately one regional coordinator per state, and all are professors of mathematics in public universities chosen by the central agency. They are responsible for clustering the schools into groups based on their location and assigning each cluster an Application Center where the students take the exam. The exam consists of 20 open-ended questions and lasts 3 hours. The content is not entirely connected to the regular curriculum. Instead, it focuses on deep understanding of basic mathematical concepts.

[14] The assignment of the medals also depends on the student's state - as there are minimum numbers of silver and bronze medals given to each state. The assignment of honorable mention, however, depends only on the position in the national ranking.

[15] One can imagine that students can infer their score by checking the solution for the exam. However, the exams are not comparable across years, which makes it hard for students to learn their position in the distribution. For example, in the data the cutoff varies by 10 to 30 points on a 1-120 point scale. Moreover, the organization does not disclose statistics about the scores of past winners, just their rank and identity.

high school[16]. The third component is a ceremony where the award winners are celebrated. This ceremony is not a formal or mandatory event. Some regional coordinators organize ceremonies; others do not. Beyond these Math Olympiad-sponsored ceremonies, there is much anecdotal evidence that schools and municipalities organize celebrations themselves. The information shock and the ceremony, when there is one, leverage the encouragement channel.

There are two reasons that make the Honorable Mention award the appropriate variation to answer the question of interest. First, due to the large number of Honorable Mention awards, there is more density around this cutoff than other medal cutoffs. For example, there are 10 times more students right at the cutoff of Honorable Mention than there are at the Bronze medal cutoff. This feature is important for being able to statistically identify an impact on peers that is potentially small in magnitude. Second, unlike the Honorable Mention award, the medals come with a prize. Medal winners receive an annual scholarship, participate in a math training, are assigned an adviser who is a professor of mathematics from a public university, and can participate in a national ceremony attended by the president of Brazil. Therefore, the medal discontinuity is a bundle of interventions which confounds the award impact and the resource that automatically comes with it. The existence of such prizes, however, helps to leverage the public recognition aspect of the award as it is an award in a nationally known and highly competitive tournament.

Several characteristics of the school system are important for interpreting the results. Teachers and classmates are likely to know about the award winner. They can check the Math Olympiad website as well as learn about the award in school. The Honorable Mention certificates are sent to the schools, and the school staff is responsible for distributing the certificates in the classrooms. There are around 31 students per classroom. The students in a given classroom take all subjects together for at least one year. It is also common for the same class to remain together for several years. In the data, around 50% of the students stay in the same classroom as the winner in the following year.

[16] Alternative sources of information would be other years of the Math Olympiad or similar competitions in other subjects. Other competitions, however, usually focus on a population of students who score higher in the distribution than those who score around the Honorable Mention cutoff. For example, the Brazilian Olympiad of Physics in Public Schools has only 3,500 awards, vs. 33,000 awards that are given in the Math Olympiad http://www.sbfisica.org.br/ obfep/.

3 Data

This section describes multiple sources of data that fulfill three purposes. The first set of data allows me to identify the participants (narrow losers and narrow winners) and their peers - students who were classmates with the participant at the time the award winner was announced. I then describe all the performance outcomes that I use to assess performance throughout the ability distribution and overtime. Finally, I describe the auxiliary variables that I use as a control and to elucidate the mechanisms behind the results.

I use two data sources to construct the sample of participants close to the threshold and their classmates. Both are based on information that refers to, and was reported during, a period prior to the assignment of the award. I use the administrative data of the Math Olympiad from 2009 to 2012 to construct the score margin and the award cutoff for all participants in the Math Olympiad. As mentioned in the context section, the score margin is based entirely on the 2^{nd} phase of the Math Olympiad and can be interpreted in standard deviation units of the 2^{nd} phase exam[17]. I use information from the School Census of K-12 Education to recover the identity of the classmates of the Math Olympiad participants. This census is an annual survey filled out by schools in Brazil. A large share of the educational budget is determined based on the enrollment figures in this census, and in recent years, the government has begun auditing the census information; thus misreporting can have consequences. I therefore believe this survey to be accurate and reliable.

I use several educational outcomes in order to have a comprehensive assessment of impacts on students' performance throughout the ability distribution. I designate the year the student takes the exam and is recognized as t. Most outcomes are measured in the following year ($t+1$). The exact time within the 1-year range is presented in Figure 1. The Math Olympiad is my primary source of academic performance. I use participation in the Math Olympiad 2nd phase exam and the students' performance on the MO 2nd phase exam (from now on, MO Exam) as measures of MO performance.[18] This set of outcomes has the advantage of being available for

[17] The original scores were not comparable across years. In order to use several cohorts in the same specification, I standardized the annual scores to have mean zero and standard deviation one. Therefore, the score margin used throughout the paper is in standard deviation units of the Math Olympiad score.

[18] Throughout this paper, the phrase "MO Exam" refers to the MO 2nd phase exam. I do not use information about the scores in the first phase of the Math Olympiad. As mentioned above, the awards are assigned based only on the students' performance on the 2nd phase exam, which has centralized grading and is therefore less prone to manipulation.

all grades and for consecutive years for the same student. I complement the Math Olympiad outcomes with a variety of student-level performance variables. The data sources and outcome variables are as follows: From the Census of K-12 Education, I construct measures of whether students dropped out of school and students' grade attainment. From the administrative data of the *Brazilian college entrance examination*, I use measures of students' participation and score performance on the Brazilian SAT (henceforth called the SAT)[19]. From the administrative data of the *Secretary of Education in the state of Sao Paulo - SEEDUC-SP*, I use Math and Language test scores on a low-stakes standardized exam.

To assess the medium- to long-run consequences of the award, I use additional outcomes. First, I use the Math Olympiad outcomes measured two years after the award ($t + 2$). This allows me to measure the degree of persistence of the impacts. In addition, I use tertiary education outcomes, which come from the Brazil Census of Post-secondary Education[20]. The outcome variables are: Enrollment in any tertiary education and Enrollment in selective colleges with different degrees of selectivity. I construct a measure of college selectivity by ranking all colleges by the SAT score of the average admitted student.[21]

To assess the interdependencies between peers and participants inside the classroom, I leverage individual-level information from different sources. First, I use variables that are assessed prior to the award. I use the gender and race reported in the Census of Primary and Secondary education at time t. For students' performance, I use student-level performance on a national standardized exam two years prior to the award $t - 2$. This is from *Prova Brasil*, administered by INEP. Prova Brasil is bi-annual standardized exam available since 2007 and administered to 9th and 5th grade students in all public schools with at least 20 students in one of the grades.[22] Second, I use school choice and measures of educational inputs both measured in years after the award was assigned to shed light on the scope of the impact and mechanisms. The data source for these

[19]Both the Census of K-12 and the Brazilian SAT are administered by Instituto Nacional de Estudos e Pesquisas Educacionais Anisio Teixeira- INEP http://portal.inep.gov.br/home

[20]Administered by Instituto Nacional de Estudos e Pesquisas Educacionais Anisio Teixeira- INEP http://portal.inep.gov.br/home

[21]Admission to college in Brazil is to a major-college combination rather than just to a college. To simplify for readers who are not used to the Brazilian context, I treat each college-major combination as a separate college.

[22]This data was not used as an outcome for a few reasons: first, it is not available for 11th grade, which is the grade that all the analysis, including the comprehensive set of outcomes, refers to. Second, unlike the other sources, it is given bi-annually rather than annually. Lastly, since there is data from the *Secretary of Education from the State of Sao Paulo* about standardized test scores, the Prova Brasil, which refers to the same type of outcome, would add little to the analysis.

variables is the Census of K-12 education, and I use the following outcome variables: whether the student transferred to another school, the student's subsequent classroom assignment and several measures of the classroom's composition in terms of students' and teachers' characteristics.

I use school-level information as controls. To obtain a unique measure of school quality for students in all grades, I combine information from Prova Brasil for primary schools and the SAT for secondary schools.[23] I use the position of the school in the quartile of the national distribution as a measure of school quality.

3.1 Sample Selection

I take a number of steps to restrict the sample used in the empirical analysis. I depart from the universe of 1.5 million 6^{th}-11^{th} grade participants in the 2009-2012 Math Olympiad (and approximately 45 million of their classmates). To identify the individuals across data sets, I follow the procedure explained in detail in Section A.2. I restrict my sample to students who were uniquely identified using this procedure (based on information that refers to and was reported during a period prior to the award). I therefore exclude *30%* of participants (and their classmates).

The second restriction concerns students who score right at the cutoff point. Due to the discreteness of the score scale, there are a number of students who score right at the cutoff point. The Math Olympiad organizers use tie-breaking criteria that depend on the degree of difficulty of the questions. Since the criterion for ranking the students at the cutoff is constructed *ex-post* and is different from the criterion for ranking the remainder of students, I leave the students who score right at the cutoff point out of the sample. I therefore exclude an additional *.3%* of the initial sample of participants.

The third restriction is due to the definition of the running variable. In the ideal experiment, we would recognize one student in a classroom and observe students' performance relative to the control classroom where no award was given. In practice, there are classrooms with multiple award winners and classrooms with a narrow loser together with a winner. To make the treatment

[23]Including SAT data is necessary as it is the only source of national data for the universe of secondary schools. For students enrolled in 6^{th}-9^{th} grade, I rank their schools based on the average score on the *Prova Brasil* Exam in the year prior to the award.[24]. I divide the schools into quartiles based on their rank and use their position in terms of quartiles as the measure of school quality. For students enrolled in secondary school, I do the same procedure but instead of using *Prova Brasil*, I use the performance on the Brazilian SAT, as it is the only national test available for secondary schools.

interpretation as close as possible to the ideal experiment, the running variable (and so the treatment) is defined for the highest- scoring student in the classroom. This excludes an additional *26%* from the initial sample.[25]

The final sample consists of 700 thousand (43% of the initial sample) of Math Olympiad participants enrolled in 6th-11th grades. Close score participants account for 170,000 students, with a total of 5 million classmates. I explain the close scores definition in the next section. Section 3.2 presents summary statistics comparing participant vs. classmates as well as classrooms within the RD sample vs. the full sample.

Sample limitations. All the results reported in this paper are based on the final sample described above: Math Olympiad participants enrolled in 6th-11th grades who satisfy the three sample restrictions. There are two exceptions where I use a more limited sample.

First, when I use the comprehensive set of outcomes (performance outcomes that do not refer to the Math Olympiad), I restrict the sample to 11th grade students only. Unlike the Math Olympiad outcomes, these additional outcomes are not all available for all grades.[26] For example, students only take the SAT in the last year of high school. Since all outcomes are available for the 11th grade, I present results for the 11th grade and in Section A.1 I show that for the set of outcomes that is available for all grades, the results including 6th-11th grades are similar to those just including 11th grade. I make it explicit in the Tables and Figures when the sample is restricted to 11th graders only. Second, on top of being restricted to 11th graders, the results based on heterogeneity of pre-award students' performance impose an additional restriction. Pre-award students' performance is only available for one of the years of the Math Olympiad, 2011.[27] Only Table 9 has both restrictions - it includes only 2011 and is restricted to 11th grade.

3.2 Summary statistics

This section provides summary statistics for the participants (close to the award threshold) and their classmates, as well as compares classrooms within the RD sample and the overall sample.

[25]The share of students around the cutoff who were 1st highest, 2nd highest and 3rd highest in the classroom were respectively 76%, 14% and 4%.

[26]Dropout, Grade Attainment and Math Olympiad are available for all relevant grades 6th to 11th; Low stakes test score is available for 9th and 11th grade; SAT and college is available for the 11th graders only.

[27]I use *Prova Brasil* 2009 as a source of pre-award $(t-2)$ test score information for 9th graders who after two years are in the 11th grade.

The regression discontinuity design that I implement relies on the assumption that relevant factors that determine the outcomes vary smoothly around the threshold. I test this assumption in Section 4. While average levels of students' characteristics and performance are not relevant for internal validity, they are still relevant for external validity and interpretation of the results.

Characteristics of participants (who score close to the award threshold) and their classmates. Table 1, Panel A compare participants and their classmates within the RD sample. Participants have greater educational outcomes compared to classmates; for example, they are 3 times more likely to enroll in selective colleges. A participant is also slightly more likely to be white and male than a classmate is, but the differences are small. For example, 46% of participants are female, while 52% of classmates are female.

Classrooms characteristics in RD window vs. in full sample. Table 1, Panel B compares classrooms in the RD sample with the full sample. The Regression discontinuity method estimates a Local Average Treatment Effect - LATE. The summary statistics are useful for understanding the profile of students for whom the results are representative. The classrooms in the RD sample come from better schools than in the full sample, but there is a reasonable number of schools in all quartiles of the national distribution of school quality. For example, 10% of schools in the RD sample come from the bottom quartile. The schools in the RD are also larger and more likely to have had a student who won the award in the past two years.

4 Empirical strategy

To estimate the impact of the award, I use a regression discontinuity design comparing students who had an award winner in their classroom to a control group - a classroom in which the participant earned a score similar to that of the award winner, but narrowly lost the award. I discuss the challenges this research design overcomes, the specification choices made, the assumption it implies, and lastly, the threats to the identification strategy.

There are two main empirical challenges that this research design overcomes. First, the students who receive the award are usually stronger to begin with. I therefore narrow the comparison to classrooms where participants scored close to the threshold but some were not recognized with an award because of limits in the total number of awards given every year. The second challenge is due to the possibility that an award can determine the peers and classmates of a recognized student, making the network endogenous to the treatment. In my setting, this is not a issue because the classmates are defined as the participants' classmates at time t, prior to the announcement of the award winners.

As emphasized, participants' assignment to treatment is determined by their score on the 2nd phase Math Olympiad Exam relative to the award threshold. The threshold is determined by the lowest-scoring participant to receive the award, considering the category in which the student competes[28] 98% of students who score greater than the award threshold receive the award. I therefore implement a sharp discontinuity design.

I follow standard methods for regression discontinuity analysis (as in Lee and Lemieux (2010)). My main specification restricts the data to a small window around the threshold and estimates an ordinary least square (OLS) regression using a flexible linear specification (as in equation 1). I present results for three different chosen bandwidths. First, for each outcome I implement the procedure proposed by Imbens and Kalyanaraman (2011) to estimate the optimal bandwidth and report the results for that bandwidth. This results in different samples for different outcomes. In order to keep the sample consistent across different estimations, I report two other bandwidths. I report the minimum optimal bandwidth considering all outcomes and the average optimal bandwidth. I define a close score as one where the difference between the participant's score and the award cutoff falls within the different bandwidths - average optimal bandwidth: .82 s.d. of Math Olympiad exam [Main]; minimum optimal bandwidth: .62 s.d. of Math Olympiad exam; individual outcome optimal bandwidth.

In Section 6 I present two robustness checks to this main specification. First, I report how the results vary for alternative bandwidths - .32, .42, .52, .72, .82 standard deviations. Second, I relax the linearity assumption and estimate a non-parametric local linear regression.

Terminology: Participant and Classmates Throughout the paper, *participant* and *classmates* each refers to a specific group of students. A participant is the narrow winner or narrow loser who scores close to the award threshold. Due to the sample selection (see Section 3.1), there is

[28]For example, all students in a given year competing at a certain level experience the same cutoff. Only in 2012 did some school characteristics start to matter for the allocation of the Honorable Mention Award. In 2012, the Math Olympiad established a minimum number of awards to be awarded in each of the 27 states, as well as a maximum number of awards that could be assigned to students enrolled in selective schools (e.g., schools that use exams in their admission process).

only one participant per classroom. There may be other students in the participant's classroom who also participated in the Math Olympiad, but I do not refer to those students as participants. Classmates are students in the same classroom as the participant at year t. Classmates could have participated in the Math Olympiad or not. Regardless, they are included as Classmates.

The specification is always at the individual level, estimated separately for the participant and for the classmates. The specification for the participant is:

$$y_{ck} = \alpha + \beta Award_{ct} + \lambda Score_{ct} + \delta Award_{ct} \times Score_{ct} + \gamma_c^{grade} + \gamma_t + \varphi X_{ct} + \varepsilon_{ct}; \tag{1}$$

estimated for participants whose scored margin of loss or win is less than the selected bandwidth, where y_{ck} denotes the outcome y for a participant in classroom c at time $k = (t, t+2]$ assessed after the award is announced at year t. In principle, there could be many winners per classroom, c. As explained in 3.1, the variables are defined for participants who earned the highest score in the classroom. Therefore, there is only one narrow winner or loser per classroom, c. The model includes variables all determined at year t. γ_c^{grade} and γ_t are a set of grade fixed effects and Math Olympiad cohort-year fixed effects; X_{ct} are controls for school quality. $Score_c$ is the participant's score normalized to be zero at the award threshold. It is therefore the running variable. The variable $Award_c$ is a indicator function equal to one if the participant scored above the award cutoff ($Score_c \geq 0$). The coefficient of interest, β, captures the effect of the award on outcome y.

The specification for the classmates of the participant is analogous:

$$y_{ick} = \alpha + \beta Award_{ct} + \lambda Score_{ct} + \delta Award_{ct} \times Score_{ct} + \gamma_c^{grade} + \gamma_t + \varphi X_{ct} + \varepsilon_i; \tag{2}$$

Where y_{ick} denotes the outcome y for a classmate i in a classroom c at time $k = (t, t+2]$ assessed after the award being announced at year t. The model is exactly the same with the following differences: First, it is estimated at the classmate level. For each classroom, there are around 30 observations (number of classmates). Since the award treatment is at the classroom level, I cluster the standard errors at the classroom level.

The main outcome y for the participant and for classmates measures the student subsequent performance in the Math Olympiad assessed at $t+1$. As explained in the data section, I complement this with a comprehensive set of 9 outcomes all assessed at $t+1$ spanning outcomes relevant for students throughout the ability distribution. I present the results of each individual regression as well as on a summary measure following Kling, Liebman, and Katz (2007).[29] I run seemingly unrelated regression (SUR) to compute an effect size $\hat{\beta}$:

$$\hat{\beta} = \frac{1}{K}\sum \frac{\hat{\beta}_j}{\hat{\sigma_j}} \tag{3}$$

In equation 3, $\hat{\beta}_j$ are the point estimates obtained for estimating equation 2 for each of the outcomes. ${\sigma_j}^{\hat{control}}$ is the standard deviations of the outcome for the control group, and K is the number of outcomes included in the summary measure (In this case $K = 9$). I use bootstrapping to obtain standard errors for $\hat{\beta}$.

Validity of Identification Assumption. The identification assumption is that relevant factors that determine outcomes vary smoothly around the threshold; thus any discontinuity after the award is the result of the treatment assignment. While it is not possible to directly test this assumption, we provide evidence that the assumption holds in this setting. First, we find no evidence of manipulation around the award cutoff. As I emphasized previously, the award threshold is unknown ex-ante, and empirically varied over the years by 10 to 30 points on a scale of 1-120 points. This makes any manipulation unlikely. The density is indeed smooth around the award threshold as reported in Figure 3. Using the Frandsen (2016) test, I do not reject the hypothesis the density is smooth around the threshold.[30] I also test for smoothness in pre-award characteristics and lagged outcomes. Figure 4 and Tables 2 report the results. Since there are outcomes available for all grades, and some available only for 11$^{\text{th}}$, I test for discontinuity separately for both samples. I use school-level characteristics and student characteristics and outcomes. Out of the 52 tests, 0 are significant at 5%, and 5 is significant at 10%. Overall this lends support to the identification assumption of continuity of pre-award characteristics around the award threshold.

[29]The results are similar if instead of including all 9 outcomes I make an intermediary aggregation into 4 components - progress in school index (=1, did not dropout; =2, grade attainment; =0 otherwise), Standardized test score , SAT index (=1, if enrollment in SAT; =2, whether the student scored in the top 50th percentile; =3, whether the student scored in the top 30th percentile; 0, otherwise), MO index (=1, whether the student qualified to the Math Olympiad, =2, whether the student show up to the exam, =3, whether the student scored in the top 30th percentile; =0, otherwise)

[30]The Frandsen test is an alternative to McCrary that is appropriate when: i) the running variable is discrete, and ii) the discontinuity is located in a segment of the density where the linearity assumption used in McCrary is not satisfied. Since in my setting the running variable is discrete and the threshold is closer to the upper tail, I use the Frandsen test.

5 Results

My main result shows that awards lead to higher performance on the part of the participant and her classmates. The spillovers on classmates are economically meaningful. The impact on the average classmates is about 1/5 of the impact on the participant and has long-run consequences, as it increases the winner's classmates' enrollment in selective colleges by 10%. The scope of the impact is consistent with behavioral changes in the classroom that explain the classmates' performance improvements. I find that the award impacts participation and learning margins, and it lasts for 1 year. I also show that proximity to the winner (both physical and in terms of ability) mediates the spillover results. The spillovers are found for students in the top quartile of the pre-award score distribution, and come from outcomes that are particularly relevant for such students, such as subsequent performance on the Brazilian SAT and in the Math Olympiad. I also find that the continued presence of the winner in the classroom mediates the spillover results. Taken together, the results suggest that the recognition of a high-performing student serves as a catalyst to enhance motivation and effort in the classroom (on the part of students and potentially also of teachers).

5.1 Effect of award on participant's academic performance

This section examines whether the award impacts the participant. In what follows, I show that the award increases the participant's subsequent academic performance. While the focus of this paper is on the peers, studying the consequences for the participant serves two purposes: it serves as a benchmark of the magnitude of the award impacts on classmates and also helps shed light on the mechanism. The encouragement mechanism that seems to explain the spillovers on classmates is also relevant for the participant. It is therefore reassuring that the award also impacts the participant's subsequent performance.

Before presenting the results, it is important to clarify a few conceptual differences in interpreting the impact on the participant compared to the impact on classmates. First, the participant is at the very top and many margins are not relevant for her. Second, the winner can use the award to signal his ability, a possibility that is not available for classmates. While in other settings this will results in having greater access to better colleges, in this setting most colleges, especially selective ones have exam-based admission. So, instead winners might be using to signal directly to access better labor market opportunities. Third, For each participant there are 30 classmates and therefore the results on this section are less precise. I present below results on outcomes that are relevant to top students, in the Appendix Table A3 you will find the results for all performance outcomes. The results are in general consistent with these three features I emphasize.

The are three educational outcomes that are likely relevant to top students: the Math Olympiad, likelihood of enrolling in tertiary education and performance in the SAT. The participation in all these measures is an active decision of the student, and the participation itself is an outcome of interest. I therefore present results on outcomes that are well defined (non-missing) for the entire sample - report impact on participation margins, and on the likelihood the student score above different thresholds. Most participants in the control group take the SAT at $t+1$, 80%, half of which enroll in college at $t+2$, 40%, and finally only 12% participate in the MO Exam at $t+1$.

Table 3, Panel A report impacts on MO participation and probability of exceeding different percentiles.[31] Students that do not participate in the MO are coded as 0 (e.g. as if he did not exceeding any percentile). The award increase participation in the Math Olympiad by 27% relative to the control group mean, and also increase the share of students scoring above the different thresholds. For example, it increases in 68% the share of students scoring in the top decile of the national MO score distribution. Finding an impact on the Math Olympiad is reassuring as it lends support that the empirical strategy is indeed capturing the impact of the award. Given the participation levels, the Math Olympiad outcomes are also the least likely to suffer from a ceiling effect.

For 11th graders, which represents 12% of the full sample, it is possible to estimate the impact on other performance outcomes. Table 3, Panel B report the impact on tertiary education at $t+2$, and Panel C impact on SAT performance at $t+1$. Due to the sample restriction the estimates are imprecise, but it is overall consistent with the award having greater impact as the outcomes have greater relevance to the top (from Panel C to Panel A). Most students already participate in the SAT (80%) and among those 60% already score in the top 30$^{\text{th}}$ of the national distribution. The award therefore does not impact participation on SAT, the magnitude on the coefficient is actually

[31] I don't present the impact on raw scores because participation is affecting the marginal score. I discuss in detail the choice of the variables in the next section.

negative. This is consistent with the idea that the award might be helping winners to get access to job opportunities and postponing plans to apply to college. The magnitude is however very small and statistically not significant. There is a positive impact on the share of students scoring at the very top of the SAT distribution as well as increases in enrollment in selective colleges. These results are however statistically weak, and not robust using other bandwidths. Figure 5 presents the regression discontinuity plots one for each of the different margins, Math Olympiad, SAT and College. I present RD plots corresponding to participation and other thresholds in the appendix. Overall there is a robust impact on Math Olympiad related outcomes and at most weak impacts on other margins.

5.2 The spillovers to classmates

In this section I investigate whether the award impacts classmates. I first present the effects on the classmates' performance in the Math Olympiad at $t+1$. This helps make the case that the impacts I document are indeed a consequence of the award; it also allows me to benchmark the results with those of the paper closest to this one Sequeira et al. (2016). I then investigate the scope and persistence of the spillover effects.

Figure 6 reports classmates participation in the Math Olympiad at Year $t+1$. The outcomes are grouped in .1 standard deviation bins around the award threshold. The figure shows that even within our relatively small bandwidth there is a general increase in students participation (y-axis) as the score of the participant in t increases (x-axis). The increase in participation observed just above the threshold appears to be a level shift, with very similar slopes in both sides of the threshold. The award is associated with a increase in participation of 5.26% relative to the control group mean.

Table 4 Panel A reports the corresponding regression results. The first and second column report results without and with controls, for the smallest bandwidth. The following columns includes controls and varies the bandwidth. The estimates are stable across the different specifications, and all statistically significant at 5% level.

Benchmark for Magnitude of Effects: vs. Participant. The Math Olympiad outcomes offers the most precise estimates of the impact of the award.[32] It is therefore the best place to compare

[32]this is due to the fact that the sample is restricted to 11th graders for the other outcomes

the magnitude of the impact of participant and classmates. The award increase classmates' participation by .13 percentage points, while it increases participant's participation by 3.48 p.p. The absolute impact is therefore 27 times larger for the participant. However, only 2.5% of classmates in the control group participate in the Math Olympiad at $t+1$ (compared to 13% of control participant). Therefore, relative to the respective control group mean, the impact on classmates is about 1/5 of the impact on the participant.

Benchmark on current knowledge. The closets paper to this one studies the consequences of a merit scholarship in India on the peers of the winner, studying the consequences only on outcomes related to beliefs and interests rather than academic outcomes. The authors find that the award has no impact on peers' beliefs about returns to education, but does increase the share of the winner's peers reporting that they plan to apply to the scholarship by 20%. In my setting, a non-monetary award Increases classmates actual participation by 5.6%. This offers a good benchmark to the state of knowledge on how the recognition of a student affects the peers. In what follows, I will expand on their contribution to understand whether the recognition result in greater learning (or just, as their results suggest, greater participation), whether it expands to other academic outcomes and also how persistent are the impacts.

Figure 7 and Table 4, Panel B, present the results on whether the award impacts the classmates' Math Olympiad score at $t+1$. The award is associated with a 2.93% increase in standard deviations of the Math Olympiad national distribution. One should be cautious in interpreting this as evidence of greater students' learning, as the award might change the composition of students. While it is likely that the marginal student, for who the award influenced participation, has lower ability than the ones that would have participated in the absence of the award, one cannot be certain without further evidence. For a sub-sample of students we can provide an empirical test for whether the award impacted the composition of MO participants[33]. Table 5 test for the impact of the award on the pre-award test score of students who participate in the MO exam at Year $t+1$. As expected the award decreases the average ability of students who participated at $t+1$. This lends support that the award did not only increase classmates' participation, but also their learning. I follow Angrist, Bettinger, and Kremer (2006) strategy to derive non-parametric bounds

[33]The sub-sample is determined due to data availability. Precisely, the students who participated in the State of *Sao Paulo* standardized exam two years prior to the award

on the impact of the award on MO scores. As Table 5 shows that the selection bias is negative, selection-contaminated comparisons provide a lower bound on the likely impact of the award on achievement. For the upper bound I make a correction on the treatment sample which consists of including only the upper part of the distribution of scores - which assumes that the students that wouldn't have participated in the absence of the award would have scored at the bottom of the distribution. Table A1 report the results. The bounds for the classmates are tight, vary between 0.0293 up to 0.0341 standard deviations.

Both margins, participation and learning, capture margins of effort and consequences of awards more generally and, therefore it is important to measure the consequence for both. Considering the question of interest, changes in participation is particularly interesting as it speaks directly with the choices the students make. In the analysis that follows, many of the outcomes also have participation as a students' choice, and so together with the actual test performance the participation is an outcome of interest. Instead of documenting the existence of selection for each outcome I follow Angrist, Bettinger and Kremer (2006) and present the results on participation as well as on the probability of exceeding different percentiles of the corresponding score distribution. It seems unlikely that students that score at the very top were at the margin of not participating in the MO and SAT, for example. To shed light on whether there are impacts on learning margins, I chose to report probability of exceeding the median, as well as each of the four subsequent deciles. The results on how the award impact the Math Olympiad (that I just presented) using this alternative procedure is reported in Table 6. Whenever I have to reduce dimensionality, I use the Probability of exceeding the median (Table 6, column 2)[34]. The results are very stable for the different percentiles and whenever I reduce dimensionality I present in the Appendix how the results look like if instead I use Participation in MO exam and other percentiles. I mention in the main text when the conclusions differ.

[34] Alternatively one could use two other ways to reduce dimensionality: i) summary measure with all this variables. However, since the standard deviations are mechanically smaller as the percentiles grows, this would result in greater weighs to, for example, exceeding 90th percentile, which is not necessarily desirable. ii) Use a probit. The probit has the inconveneince in a RD strategy as the corresponding estimates would not represent what we see in the RD plots. Reporting one of the outcomes (MO score exceeding the median) and doing robustness with other outcomes was my preferred choice

5.2.1 Impact on outcomes that are relevant to students throughout the ability distribution

Does the award impact all classmates equally no matter his level of ability? In this section I show that the spillovers are found for top students, having little effect for other students.

On average 5% of the classmates participate in the Math Olympiad. Even if the award had negative consequences on students at the bottom or at the middle of score distribution, it would likely not affect their Math Olympiads outcomes. To understand the consequences of the award for students in different parts of the ability distribution, I implement two strategies[35]. First, I estimate the impact on a variety of outcomes that are relevant to students in different parts of the ability distribution. Second, I conduct heterogeneous analysis based on pre-award test score. To that end, I put together a variety of data sources. This comes however with a constraint as the new outcomes are not all available for all grades[36]. Since all outcomes are available for the 11th grade, I present results for the 11th grade and in the Appendix Table A3 I show that the results for 11th grade are similar for the full sample for the outcomes that are available for all grades.

Table 7 presents the impact of the award on SAT performance. Similar to the analysis on the winner I present the impact on the likelihood of participation, as well as on the student's probability of exceeding different score percentiles. The award increases participation in the SAT by .89 percentage points and in .46 p.p. likelihood that the student score in the top 20th percentile of the score distribution. It seems unlikely that many students that end up scoring in the top 20th percentile of the score distribution were not participating in the SAT in the first place. This lends further support that the award impacts not only participation but also students' learning. Figure 9 presents the corresponding RD plot associated with the SAT results. The online Appendix presents additional RD plots corresponding to other percentiles and enrollment in SAT.

Benchmark for Magnitude of Effects: vs. Private secondary school vouchers Angrist, Bettinger and Kremer (2006) study the impact of providing secondary school vouchers in Colombia on participation and performance in the Colombian SAT. The similarity of the context and the out-

[35]A alternative strategy to get at impacts at different parts of the distribution which is more robust to outliers than studying impacts on the average, would be to implement a quantile regression. However, all the performance measures which are affected by the award (SAT and Math Olympiad) suffers from endogenous participation, and are also only available for a segment of the ability distribution. MO scores are available for the top 3%, SAT score is available to top 55%. Implementing a quantile regression in such cases would report a incomplete story as it would miss a large portion of the ability distribution.

[36]Dropout, grade Attainment and Math Olympiad are available for all relevant grades 6th to 11th; Low stakes test score is available for 9th and 11th grade, SAT and college is available for the 11th grade only

comes used makes this estimate the best one to benchmark the impact of the award to a alternative policy in education. The authors find that the voucher increased the probability the student score exceeded the 50^{th} percentile by 4.3 p.p. (from a baseline level of 44.5%). This represents a increase of 9.8% relative to the control group mean. As reported in Table 7 the impact of the award on the peers increases the probability the classmate score in the top 50th percentile by .92 p.p. The raw impact is about 1/5 of the impact of providing the voucher to the student. Relative to the control group mean the comparison of the respective samples, the award impact is about 1/2 of the impact of providing the voucher. The voucher covered about half of the cost of the school tuition having a value of approximately 190 US dollars (equivalent to 8.3% of per capita GDP in Colombia at the time). The impact that I document here is therefore large. Especially taking into account that the award estimate is only capturing the ex-post effect of awards, rather than the entire effect of awards.

Table 8 report the award impact on a comprehensive set of outcomes, spanning outcomes relevant throughout the ability distribution all measured at $t+1$. The outcomes are: no dropout, grade attainment, low-stakes state of Sao Paulo standardized test score, Participation in Brazilian SAT, SAT Score in top 50^{th} percentile, SAT score in top 30^{th}, Qualified to Math Olympiad, Participation in Math Olympiad, Math Olympiad Score in top 30^{th} percentile. The inclusion of dropout, grade attainment and test score is straightforward. The choice regarding the selection of outcomes measuring performance in the SAT and the Math Olympiad deserves a detailed explanation. Participation on SAT and MO is a active choice of students. To measure performance on this measures I therefore include not only their participation but also whether the score exceeded different percentiles. As shown in Table 7 the results on the SAT measure are almost identical if I use neighbor percentiles. The results, therefore, do not depend on this exact selection of variables.

Overall there are a few interesting patterns worth emphasizing. First, the magnitude of the impact is larger for outcomes that are more relevant to top students such as SAT and Math Olympiad (and later on I will show that the same holds for college enrollment as well). This pattern is also similar within a specific outcome - the SAT (Table 7). For example, the award increase the share of students scoring in top 50th percentile by 4% and it increases students scoring in top 10th percentile by 9.5%. Margins that are relevant for students at the middle and bottom of the distribution, such as dropout, grade attainment and test score are not statistically impacted, and magnitudes are positive and small. Second, the lack of impact on standardized test score is particularly interesting. There are two potential explanations for why there is no impact on test score. First, this is a low-stakes exam for the student while other performance measures presenting greater impact are all high-stakes for the student. Second, this is the only test score measure in which participation is not a active decision of the student. While in Table 5 I present evidence that the award impact learning and not only participation, the lack of result on test score suggests that the learning impact is small, or at least not detectable in a standardized low-stakes exam.

The second exercise is to test empirically whether top students are indeed driving the performance result. For a sub-sample of students, I have pre-award test score measured at Year $t-2$.[37]. Table 9 reports the heterogeneity analysis result. I find that students at the top quartile of the pre-award score distribution are driving the increase in the summary measure. There is some weak evidence that the award might be detrimental to the bottom. The award impact negatively students below the median, but this is not robust for the different bandwidths.

Taken together, the evidence is that the spillovers are concentrated on students at the top: i) Only affect margins that are relevant for those, MO, SAT (and as I show in the next section, College enrollment) ii) The heterogeneous analysis shows the increase in overall performance is driven by students initially at the top of the distribution.

5.2.2 Persistence of Impact

Does the impact on students achievement persist overtime? I implement two exercises to answer this question. First, I compare the impact of the award on the Math Olympiad performance assessed at $t+1$ vs. $t+2$. The impact is short lived, as there is no impact at $t+2$. Second, to get at whether there are long-run consequences I test for whether there is a impact on enrollment in Tertiary education outcomes. I find positive impact on classmates' enrollment in selective colleges.

Figure 10 reports the treatment effect on the performance in the Math Olympiad one and two years after the award has been assigned for a balanced panel of students. The impact on the participant persists, after two years the impact is statistically significant at 5% and the magnitude is 77% of the impact after one year. The impact on classmates, however, last for one year only. The impact after two years is not statistically significant and the magnitude is only 4% of the after one

[37]See data section for a detailed explanation of data availability

year impact.

Another dimension of persistence is whether there are consequences for post-secondary education outcomes. I test for whether there is an impact on enrollment in Tertiary Education after two years of the award - which is the relevant outcome for the 11$^{\text{th}}$ grade cohort that takes the SAT at year $t + 1$.

Tertiary education outcomes has a limitation which is relevant for interpreting the results. I only observe students enrollment in tertiary education if the student participate in the Brazilian SAT. The admission process in Brazilian colleges are entirely exam-based, and most colleges use the SAT in some stage of its admission process. For example, 45% of all students admitted into any post-secondary institution participate in the SAT in 2012. [38] Therefore, a candidate who are considering applying for higher education would likely take the SAT. I observe the enrollment status as long as the student participate in the SAT, regardless if he uses the SAT in the admission process of the institution he end up enrolled. Since the award impact enrollment in SAT, there will be a potential mechanical impact on college enrollment even if in practice students are not changing college decisions. To minimize this issue, I report the impact on overall tertiary education enrollment as well as on enrollment in college that presents a higher level of selectivity[39]. Students that enroll in a selective college are unlikely to be at the margin of participating in the SAT, and so an increase in enrollment in selective college is almost certain to capture a greater enrollment in college. I construct a measure of college selectivity based on the average SAT score student who gets admitted.

Table 10 presents the impact of the award on enrollment in tertiary education (and Figure 9 the corresponding RD plot). The award increases in .31 the likelihood the student enroll in a selective college (based on column 4 where the outcome is whether the student enrolled in a college that exceeds 70th selectivity percentile). This represents a increase in 11% relative to the control group mean.

Benchmark for Magnitude of Effects: Increase in earning using college wage premium estimates. The award impact on classmates' probability of enrolling in a selective college allows a natural benchmark: make it possible a rough estimate of the increase in total earnings that re-

[38]This number refers to 2012 and the importance of SAT for college admission has grown over the years

[39]the admission to college in Brazil is to a major-college combination rather than just to a college. To simplify for the reader who are not used to the Brazilian context I'm calling any college-major combination a different college

sults from one additional award given (relative to the control classroom). To do so, I combine the causal impact of the award reported in Table 10 with relevant statistics and non-causal estimates from other sources - Ferreira et al. (2014) and **?**. Specifically, I use college wage premium estimates from a Mincer equation (non-causal) assessed in 2012, average dropout rate in selective colleges in Brazil, and average per capita income in 2012. Based on these estimates, the impact of the award is equivalent to an increase in the average classmate's annual earnings of about 39 reales (2005 CPI), 0.5% of per capita income in Brazil.[40] Since the winner has, on average, 30 classmates, the aggregate effect of the spillover is substantial. For each award given, the overall increase in classmates' annual earnings 1170 reales, around 15% of per capita income in Brazil (2005 CPI).

5.3 Mechanisms: Resources vs Behavior responses

Overall the award is associated with greater achievements for participants and their classmates. So far, the impact of the award on classmates is local around the winner, impact high-ability students and has short lived consequences for classmates. In the next step, I provide further evidence of the central role of the winner in explaining the results: The improvement in classmates' performance is mediated by *the continued presence of the winner in the classroom*. One plausible explanation for this results is that the award motivates effort in the classroom, of students and potentially teachers, which then leads to greater performance. Alternatively, the award might be resulting in greater resources provided to the winners' classroom. In Section 7.1 I present empirical tests and find no support for the alternative explanation. I present the results on how the winner's presence mediates the performance improvement first, then I discuss the empirical tests for the resource mechanism.

[40] Ferreira et al. (2014) estimate the college wage premium and household per capita income in 2012. The ratio between college graduates wage earnings relative to individuals with secondary school is about 2.85 and household monthly per capita income is 670 reales (2005 CPI). Estimates of selective college dropout rate comes from Binelli et al. (2008). The authors report a dropout rate of 20% for students enrolled in public universities which are often the most selective ones. My estimates show that the impact of the award on the winner's classmates likelihood of enrolling in selective colleges is .0031 percentage points. Therefore, the increase in wage earnings for the average classmate = 39 reales =(Impact of award on classmates' enrollment in selective colleges) x [Difference in wage from college graduates and individuals with secondary education] x [Probability of graduating] = $.0031 \times [12 \times (2.71828)^{7.629} \times (1 - .35)] \times [.80]$. In the absence of college wage premium for selective colleges I make a conservative assumption that the premium is the same for selective and non-selective college. The predicted impact on earnings is therefore a lower bound of what one should expect.

5.3.1 What mediates the classmates' improvement in performance?

In addition of proximity to the participant in terms of ability, I study whether other measures of proximity to the participant also explains the classmates performance improvement. I study two dimensions: physical proximity and social proximity (similarity in terms of gender or race and length of relationship). I find evidence that physical proximity to the participant mediates the results, while I find no differential award impact by social proximity. I present first the results on physical proximity and then discuss the results on social proximity. In this section I will focus entirely on performance in the Math Olympiad as the performance improvement to be explained. This is due to three reasons: First, Math Olympiad outcomes are available for all grades which makes my sample 10 times larger than the equivalent sample for SAT for example. Second, it is the only performance outcome where I observe the same student for several years. Third, in the causal chain between the award and the consequences for the various students' performance, it is likely that the Math Olympiad should be one of the first margins that are affected. The Math Olympiad is in fact the margin in which I find the strongest results.

Physical proximity to participant. I present two set of empirical exercises which both suggest that physical proximity to the participant is a mediating factor driving the spillover results. First, I show that other classrooms in the same grade-school do not experience a performance improvement, suggesting that the presence of the winner in the classroom at year t is a necessary condition. Second, I show that the continued presence leverages the impact.

Figure 11 presents the impact of the award on school choice and MO performance at $t+1$ for the participant, her classmates and her grade-mates (grade-mates excludes participant's classmates). In the left side of the figure, I show that the award impact participant's, classmates' and grade-mates' likelihood of transferring to another school. This suggests that students outside of the winners' classroom were informed about the award as they seem to be updating their beliefs, for example, about school quality, or other aspect that made them choose to continue in the same school. On the right side I report the impact on whether the student exceeded the median score in the Math Olympiad. Participant and classmates are more likely to score above the median as a result of the award. The award does not increase the grade-mates' likelihood of scoring above the median. Moreover, we can statistically reject that the impact on classmates is the same as the impact on grade-mates (t-stat:2.77). The presence of the participant in the classroom is therefore necessary for the performance improvement. This is empirical evidence against several stories within the behavioral channel that relies on the award impacting access to information that is not specific to the classroom. For example, the award serving to inform about existence of the Math Olympiad, about the returns to math skills and about the quality of the school. Table 12 presents the corresponding regression table.

Table 11 presents the impact of the award on the likelihood the student continue in the participant's classroom at $t + 1$. The award positively impact the likelihood the students continues in the classroom.[41] Relative to the control group mean of 50.5% probability of continue in the classroom, it increase the probability by 1.7%. This is evidence that one of the mechanisms in which the award operates is through changing the likelihood that the student continue to be the winners' classmate. It is however unclear whether the continued presence in the classroom indeed explains the classmates' performance improvement. Figure 12 presents suggestive evidence that it does.

Since the award impacts the likelihood of continuing classmates, any heterogeneous analysis on whether the student continues in the classroom must be interpreted with cautious. For example, if the award impacts more high-ability students (relatively to poor performing ones) to continue in the classroom then, this bias the results in the direction of finding a greater impact for those who continue in the same classroom. If this is the case, a positive association between continue in the same classroom and performance would not be causal impact of being around the winner, but instead because top students were more likely to continue, and as shown, they are also more likely to experience a performance improvement due to the award. However, Table 11 present evidence that the bias is likely negative: Table 11 shows that students who had participated in the Math Olympiad in previous years are, if anything, less likely to continue in the same classroom compared to the average classmate. I therefore present heterogeneous analysis by whether the student continue in the same classroom.

Figure 12 presents the results on whether the impact on classmates' performance in the Math Olympiad varies by whether the student continue in the participant's classroom at $t + 1$. Students who continue in the participant's classroom experience a improvement in performance that cor-

[41] This table also present the results on whether the likelihood of continuing in the same classroom is different for low and high ability students. I discuss the findings of the heterogeneous analysis in Section 7.1

responds to 2× the impact on students who do not continue in the same classroom. Observe that I'm restricting the sample to all students who pass the grade, and therefore this is not driven by student who dropout or fail the grade who would naturally not be in the participant's classroom at $t+1$. There are two patterns worth emphasizing. First, even students who do not continue in the classroom also experience a positive impact of the award on their performance. There is therefore a residual impact even for students who are not classmates of the winner at $t + 1$. This is suggestive that the award is indeed motivating directly the classmates - rather than operating through teacher's behavior or participant's behavior change. Second, despite the difference in magnitudes, the impact on classmates who continue in the classroom, and who do not, is not statistically different. Figure 13 shows, for a balanced sample, that the overall relationship between continue in the classroom and experiencing greater performance improvement also holds for future years. For example, students that continue in the classroom at $t + 1$ experience greater performance at $t + 1$, but not at $t+2$. If, however, they continue at $t+2$ as well then they again experience greater levels of performance $t + 2$. The results at $t + 2$ however are not statistically significant. This suggests that having continued exposure to the winner in the classroom leverages the impact on the award.

Social proximity. Table 15 presents the results on whether the impact on the classmates' Math Olympiad performance at $t+1$ varies by measures of social proximity to the participant. I present three measures of social proximity: classmates and participant have the same gender, classmates and participants have the same race, classmates and participants were in the same classroom at t-1 (as a measure of the length of their relationship). Columns 4, 5 and 6 present the results respectively for each of these dimensions. The impact of the award is not statistically different if the classmate is socially close to the winner - based on any of the three dimensions. Table A7 shows that this is also the case even if we restrict the sample to include only the respective minority group (female or non-white).[42]

My interpretation of the results is that the award encourages students' and potentially teachers' effort by affecting the perceived returns to effort that refers to students' in the winners' vicinity (in terms of ability and physical proximity). Moreover, taken together the classmates' performance result are at least in part explained by classmates' change in preference or beliefs. It could be ar-

[42] I discuss the results reported in Table 15 columns 1, 2 and 3; as well as the heterogeneous analysis by gender and race below when I provide further tests on whether the results are driven by preference or beliefs.

gued that the award impact students' performance for reasons other than the encouragement of effort in the classroom. Section 7 provides evidence against several alternative mechanisms.

Preference or Beliefs? It is hard to empirically separate whether the award impact preferences or beliefs. All the results can be reconciled with either a change in preference or a more complex beliefs updating story.[43] A large literature has found gender differences in preference over competing.[44] If the award affects preference, in light of the previous literature, one should expect a greater impact on male classmates' response. Table A6, Panel B columns 3 reports this result. I find no evidence of differential impact by whether the classmate is female.[45]

6 Robustness checks

I have shown that the results presented are robust to adding controls and to three different bandwidths. In this section I show that the main results are robust to additional specification and sensitivity checks.

Figure 8 report the impact of the award on whether the classmates' MO score exceeded 50th percentile of the national distribution for a variety of specifications. I present 12 variations in total and all the results are within the 95% confidence interval. The set of alternative specifications

[43] For example, the impact on classmates performance lasts for only one year, while the impact on the participant's performance persists. This is suggestive of either a change in preference, or also is consistent with a more complex beliefs' updating story: as time passes the information is no-longer salient and therefore, students don't exert effort; alternatively it is also consistent with a story where students update their beliefs, which result in greater effort, they then don't make it and stop trying.

[44] Niederle and Vesterlund (2007), Buser and Yuan (2016), Reuben, Sapienza, and Zingales (2015)

[45] To Benchmark with this literature, I also present in Panel A column 3, the impact on the participant's performance by gender. I find weak evidence that the impact of the award is smaller for female participants relative to male participants. One interpretation for this result is that the returns to schooling for girls is smaller than for boys, resulting in smaller responses for girls. This result is the opposite as found in another setting. Buser and Yuan (2016) study the consequences of passing to the second phase of the Dutch Math Olympiad on participant's subsequent participation. They find that girls who pass are more likely to participate in future years, while the passing to the second phase does not affect boys subsequent participation. There are a few differences in the setting and specification that can reconcile mine and their findings. First, the variation I exploit captures the information content of "winning", while in their setting it doesn't. A potential explanation for the difference in results is that the male counterpart responds more to positive feedback regarding performance. In fact, Buser and Yuan (2016) use several complementary lab experiments and find evidence that boys responds positively to positive feedback while girls don't. This can reconcile both results. Another difference between their results concerns the specification. They do not include a full set of interactions between gender and the running variable in the regression. It is therefore not allowing the slope on the two sides of the regression to vary for male and female. Table A6 column 1 report the results imposing their restriction, in Panel A for the participant and Panel B for the classmate. The comparison between column 1, restricted specification, and column 3, full interaction, helps to quantify the extent the results are driven by the restriction imposed. In Panel A, the coefficient of the interaction Award x Female is similar no matter the restriction - estimated however with greater precision as there are less parameters to be estimated in the restricted model. This suggests that the restriction imposed do not drive the results. However, the analogous comparison in Panel B, shows that the results with and without the restriction, column 1 and 3 respectively, are very different. I would therefore be cautious in interpreting the results on the restricted model as in Buser and Yuan (2016)

and the explanation for testing those are as follows. Estimate using local linear, instead of flexible linear, to test for whether the results were driven by the linear functional form. Estimates leaving out each MO-year cohort and including State FE, to understand if the effect was driven by a exact year or location where implementation was more successful (or failed). Estimates using only Sao Paulo State, this is due to the fact that standardized test score is only available for Sao Paulo, and it is important to understand if the results looks similar if compared to the rest of the country (as other outcomes are available nationally wide). Finally, I present the results for 5 other bandwidths, in .1 standard deviations intervals from my the bandwidth.

The results are also robust to a permutation exercise. I implement a battery of placebo tests in the control group region and a randomized permutation test (Chetty et al. 2009) to further reject that my results could be capturing other spurious noise unrelated to the award. Figure A5 in the Appendix presents the results comparing randomized and asymptotic inference.

7 Discussion

7.1 Alternative mechanisms

My results are consistent with the award impacting behavior of students and teachers in the classroom, as long as they are close to the winner, physically or in terms of ability. In the following I investigate the extent to which my results could be explained by resource based explanations.

The production of education depends on the effort of teachers and students but also, it depends on a variety of inputs - teacher's quality, quality of peers, availability of textbooks to mention a few. The award may have changed the extent to which these other inputs are available to the winners' classroom and this is what I call resource-based explanation. I present below evidence that the award did not impact the provision of two of the most important inputs in education, teachers' quality and peers' quality. In the appendix I provide additional empirical tests for other resource-based explanations for the results. Table A8 shows that the award did not increase overall enrollment to the winners' school. A increase in enrollment would suggest that the school as a whole received greater attention from parents and perhaps greater funding. I also present evidence that the award doe not impact the likelihood the winner transfer to a private school. Greater access to private schools, which are often of better quality, could explain the participant's performance improvement.

Teacher quality in the winner's classroom do not change. When a winner is announced in the school, it is possible that the best teachers choose to teach the winner. Testing for this is difficult as teacher's quality is known to be hard to measure and often uncorrelated with observable characteristics. Considering this, the best test for whether best teachers are sorting into the winners' classroom is to understand whether the other classrooms in the winner's grade-school do worse in following years. Table 12 shows that grade-mates are not negatively impacted by the award at $t + 1$. If the pool of teachers are fix to the school, this is evidence against greater teacher sorting. In the appendix, Table A4, I present additional tests showing that the award does not impact the characteristics of the teacher that are assigned to the winners' classroom at $t + 1$.

Student composition in the winner's classroom do not change It is possible that the award increased the amount of tracking, changing the composition of students in the winner's classroom at $t + 1$. If this is indeed the case, the increase in students' performance would be a result of having better peers, which could impact directly their learning, and also change the level of instructions, which has implications for students performance, especially at the top. Table 11 had already shown that the likelihood that a high ability student continue in the winners classroom as a results of the award, is not statistically larger than the average student. In fact, if anything, the likelihood to continue classmates for high-abilities seems smaller. This is evidence against tracking.

8 Conclusion

In this paper I exploit a natural experiment in education policy in Brazil to estimate how recognition of the accomplishment of a high-performing student affects the ex-post performance of the recognized student and her classmates. To do so, I draw on a variety of administrative data sources, including measures of students' performance throughout the ability distribution, from middle-school dropout up to performance on the SAT, as well as educational outcomes with long-run implications, such as enrollment in selective colleges.

The study has three main findings. First, the award increases the participant's subsequent performance in the Math Olympiad and increases her probability of enrolling in a selective college (although college results are statistically weak). Second, the impact of the award spills over to the participant's classmates. The impact on classmates is substantial and has long-run consequences, as the award impact classmates' enrollment in selective colleges by 10%. Third, I show that the spillover results are specific to the participant's vicinity, in terms of score and physical location. Spillovers are found for students in the top quartile of the score distribution and are mediated by the continued presence of the participant in the classroom. Taken together, my results are consistent with the idea that the award increases motivation and encourages effort in the classroom - on the part of students and perhaps teachers.

One implication of these findings is that policies that recognize the accomplishment of a student, such as awards and affirmative action policies, should take into account the local spillovers they generate. In particular, the results suggest that recognizing winners from different physical locations is more effective in improving the educational outcomes of a larger number of students (through encouragement spillovers) than recognizing students in geographically concentrated areas. One limitation of this study, however, is that I cannot distinguish the importance of different aspects of success: prestige and information. Another limitation is due to the very nature of the variation I'm using - a natural experiment with limited degrees of freedom to distill the different mechanisms. While I'm confident that the spillovers are driven by behavioral responses in the classroom, separating exactly who is responding first - teachers, winner or classmates - is beyond the scope of this paper. In future work, I hope to address these shortcomings, as well as examine the further implications of recognition for classroom dynamics.

References

Angrist, J., E. Bettinger, and M. Kremer (2006, June). Long-term educational consequences of secondary school vouchers: Evidence from administrative records in colombia. *American Economic Review 96*(3), 847–862.

Angrist, J. and V. Lavy (2009, September). The effects of high stakes high school achievement awards: Evidence from a randomized trial. *American Economic Review 99*(4), 1384–1414.

Austen-Smith, D. and R. G. Fryer (2005). An economic analysis of acting white. *The Quarterly Journal of Economics 120*(2), 551–583.

Beaman, L., R. Chattopadhyay, E. Duflo, R. Pande, and P. Topalova (2009). Powerful women: Does exposure reduce bias? *The Quarterly Journal of Economics 124*(4), 1497–1540.

Bertrand, M. and E. Duflo (2016). Field experiments on discrimination. Technical report, National Bureau of Economic Research.

Binelli, C., C. Meghir, and N. Menezes-Filho (2008). Education and wages in brazil. *Mimeo IFS*.

Bradler, C., R. Dur, S. Neckermann, and A. Non (2016). Employee recognition and performance: A field experiment. *Management Science*.

Bursztyn, L. and R. Jensen (2015). How does peer pressure affect educational investments? *The Quarterly Journal of Economics 130*(3), 1329–1367.

Chung, K.-S. (2000). Role models and arguments for affirmative action. *The American Economic Review 90*(3), 640–648.

Dee, T. S., W. Dobbie, B. A. Jacob, and J. Rockoff (2016, April). The causes and consequences of test score manipulation: Evidence from the new york regents examinations. Working Paper 22165, National Bureau of Economic Research.

Diamond, R. and P. Persson (2016). The long-term consequences of teacher discretion in grading of high-stakes tests. Technical report, National Bureau of Economic Research.

Ebenstein, A., V. Lavy, and S. Roth (2016, October). The long-run economic consequences of high-stakes examinations: Evidence from transitory variation in pollution. *American Economic Journal: Applied Economics 8*(4), 36–65.

Ellison, G. and A. Swanson (2016, June). Do schools matter for high math achievement? evidence from the american mathematics competitions. *American Economic Review 106*(6), 1244–77.

Ferreira, F. H., S. Firpo, and J. Messina (2014). A more level playing field? explaining the decline in earnings inequality in brazil, 1995-2012.

Frandsen, B. R. (Forthcoming). Party bias in union representation elections: Testing for manipulation in the regression discontinuity design when the running variable is discrete. *Advances in Econometrics*.

Fryer, R. G. (2016). The production of human capital in developed countries: Evidence from 196 randomized field experiments. *in Handbook of Field Experiments*.

Fryer, R. G. and P. Torelli (2010). An empirical analysis of acting white. *Journal of Public Economics 94*(5), 380–396.

Genicot, G. and D. Ray (2014). Aspirations and inequality. Technical report, National Bureau of Economic Research.

Imbens, G. and K. Kalyanaraman (2011). Optimal bandwidth choice for the regression discontinuity estimator. *The Review of Economic Studies*, rdr043.

Jacob, B. A. and L. Lefgren (2004). Remedial education and student achievement: A regression-discontinuity analysis. *Review of economics and statistics 86*(1), 226–244.

Kling, J. R., J. B. Liebman, and L. F. Katz (2007). Experimental analysis of neighborhood effects. *Econometrica 75*(1), 83–119.

Kremer, M., E. Miguel, and R. Thornton (2009). Incentives to learn. *The Review of Economics and Statistics 91*(3), 437–456.

Lee, D. S. and T. Lemieux (2010). Regression discontinuity designs in economics. *Journal of economic literature 48*(2), 281–355.

Lyle, D. S. (2007). Estimating and interpreting peer and role model effects from randomly assigned social groups at west point. *The Review of Economics and Statistics 89*(2), 289–299.

Rao, G. (2014). Familiarity does not breed contempt: Diversity, discrimination and generosity in delhi schools. *mimeo*.

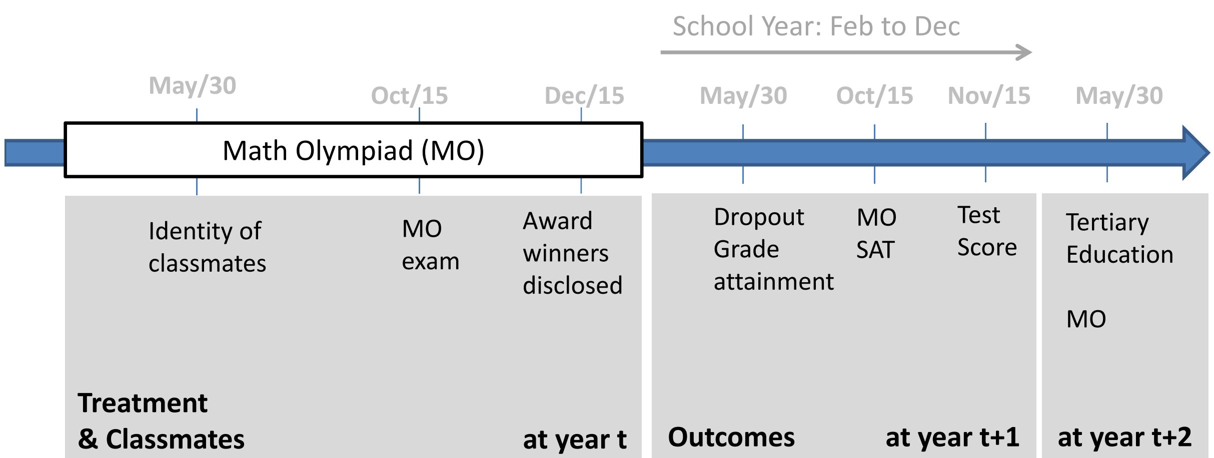
Ray, D. (2006). Aspirations, poverty, and economic change. *Understanding poverty*, 409–421.

Sacerdote, B. (2001). Peer effects with random assignment: Results for dartmouth roommates. *The Quarterly Journal of Economics 116*(2), 681–704.

Scott E. Carrell, Richard L. Fullerton, J. W. (2009). Does your cohort matter? measuring peer effects in college achievement. *Journal of Labor Economics 27*(3), 439–464.

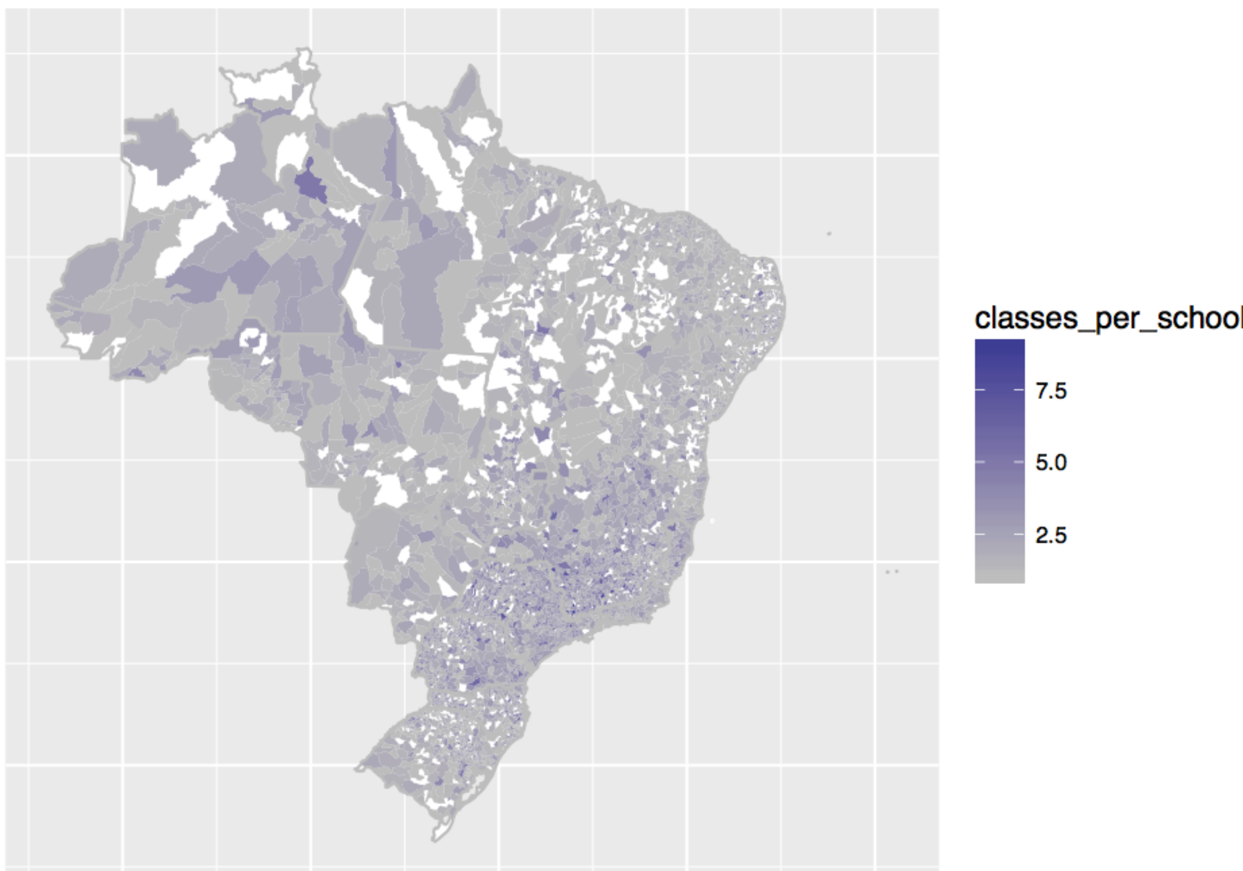
Sequeira, S., J. Spinnewijn, and G. Xu (2016). Rewarding schooling success and perceived returns to education: evidence from india. *Journal of Economic Behavior & Organization 131*, 373–392.

Figure 1: Timeline



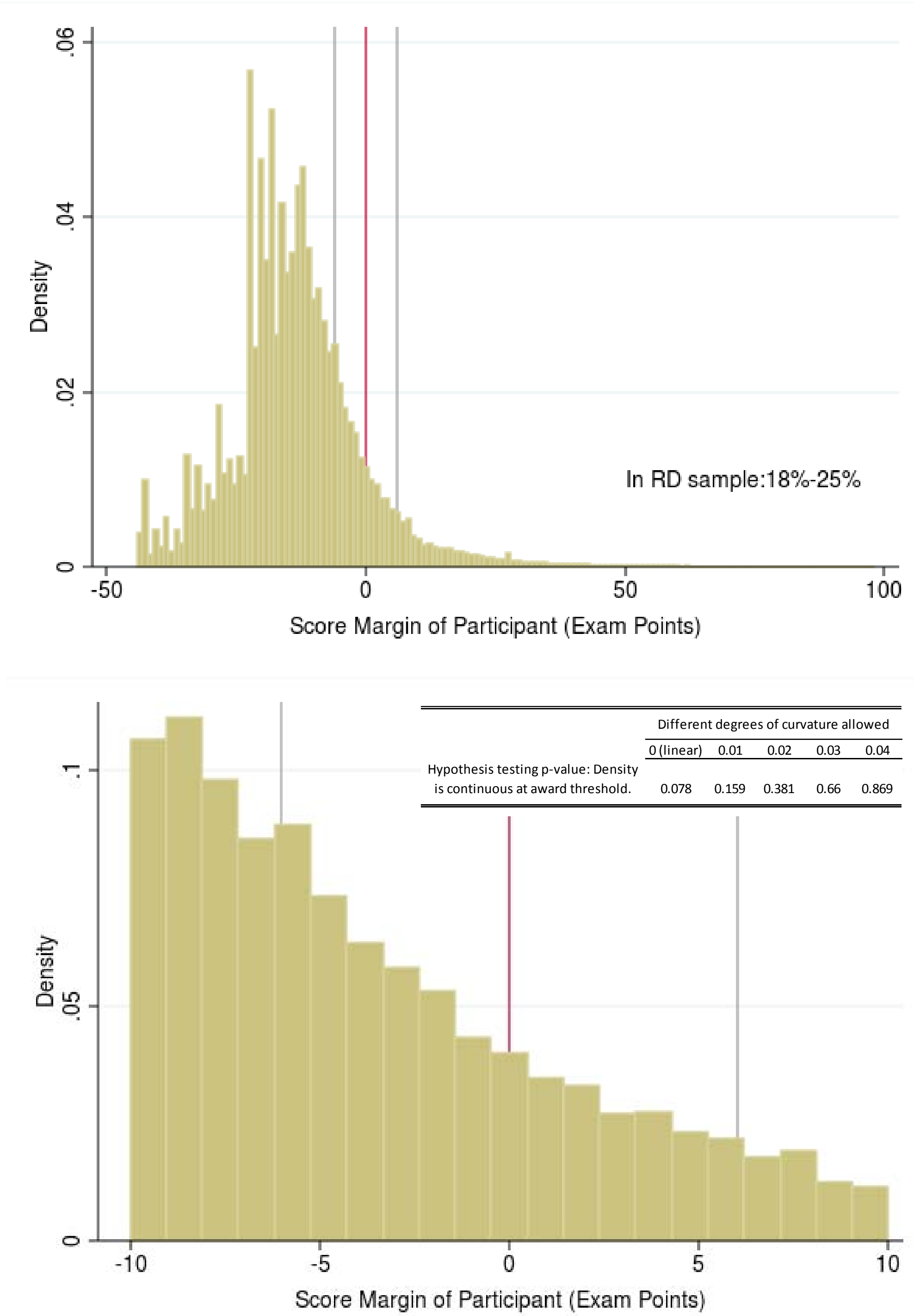
Notes: This figure presents the timeline of the Math Olympiad and the outcome variables. The Math Olympiad varied over the years the month in which the award winners are announced. I report the average month of disclosure - empirically it varied from end of November to first half of February. MO stands for Math Olympiad.

Figure 2: Average Number of Classrooms per School in the RD sample



Notes: This figure presents the number of classroom per school in the RD sample and the geographic location in the map of Brazil of the corresponding municipality where the school is located. In the map, municipalities are colored in white if there is no classroom in the RD sample in that municipality. Municipalities colored in light gray represents municipalities where there is is average one classroom per school, up to dark purple 7.5 classrooms per school. The map refers to the first MO-cohort in the sample, 2009.

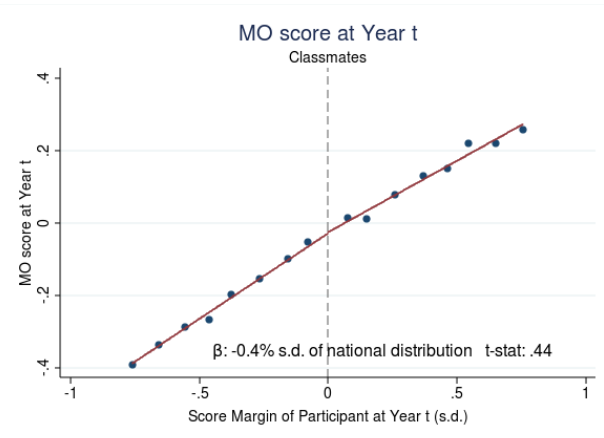
Figure 3: Density at Award Cutoff



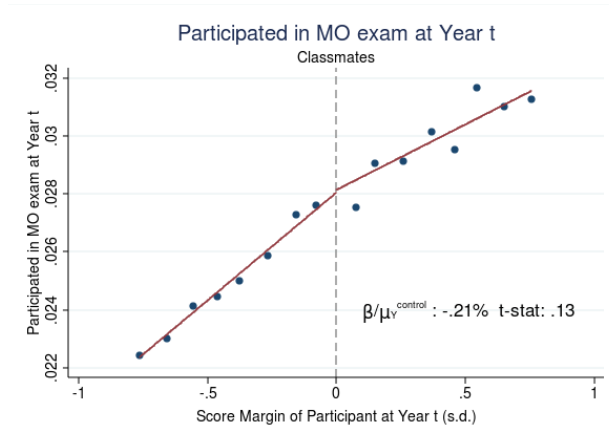
This figure reports the density of MO participants on the running variable, i.e. score margin of Math Olympiad participants. The score margin is in original points of the exam scale. Exam scale was a discrete scale from 0 to 120 points. Top figure reports density for full exam scale. Bottom figure reports density around the regression discontinuity bandwidth (18% to 25% of full exam scale sample). Bottom figure also report the results of the test for whether the density is continuous around the award threshold (similar to McCrary test) allowing for different degrees of curvature in the density function.

Figure 4: RD plots for pre-award outcomes **(PLACEBO)**

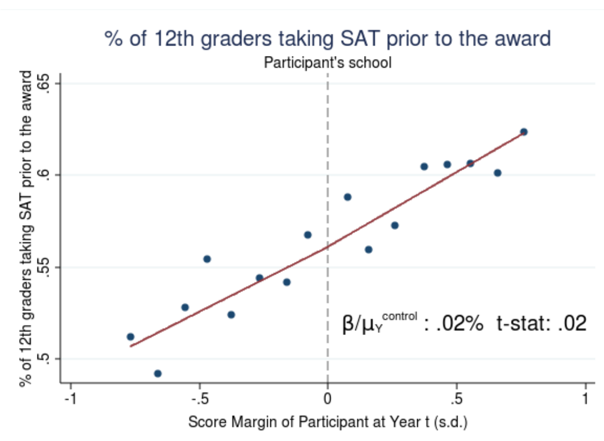
(a) Classmates



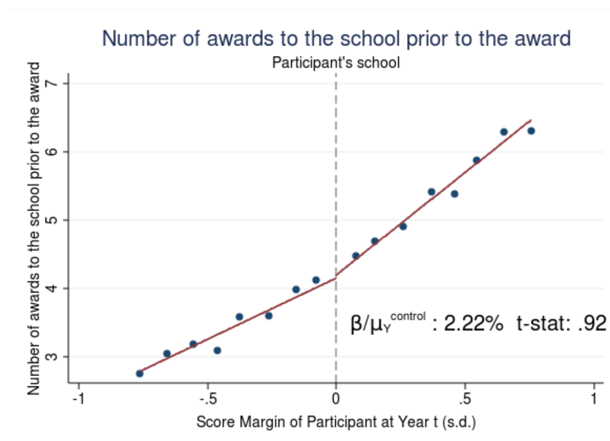
(b) Classmates



(c) School

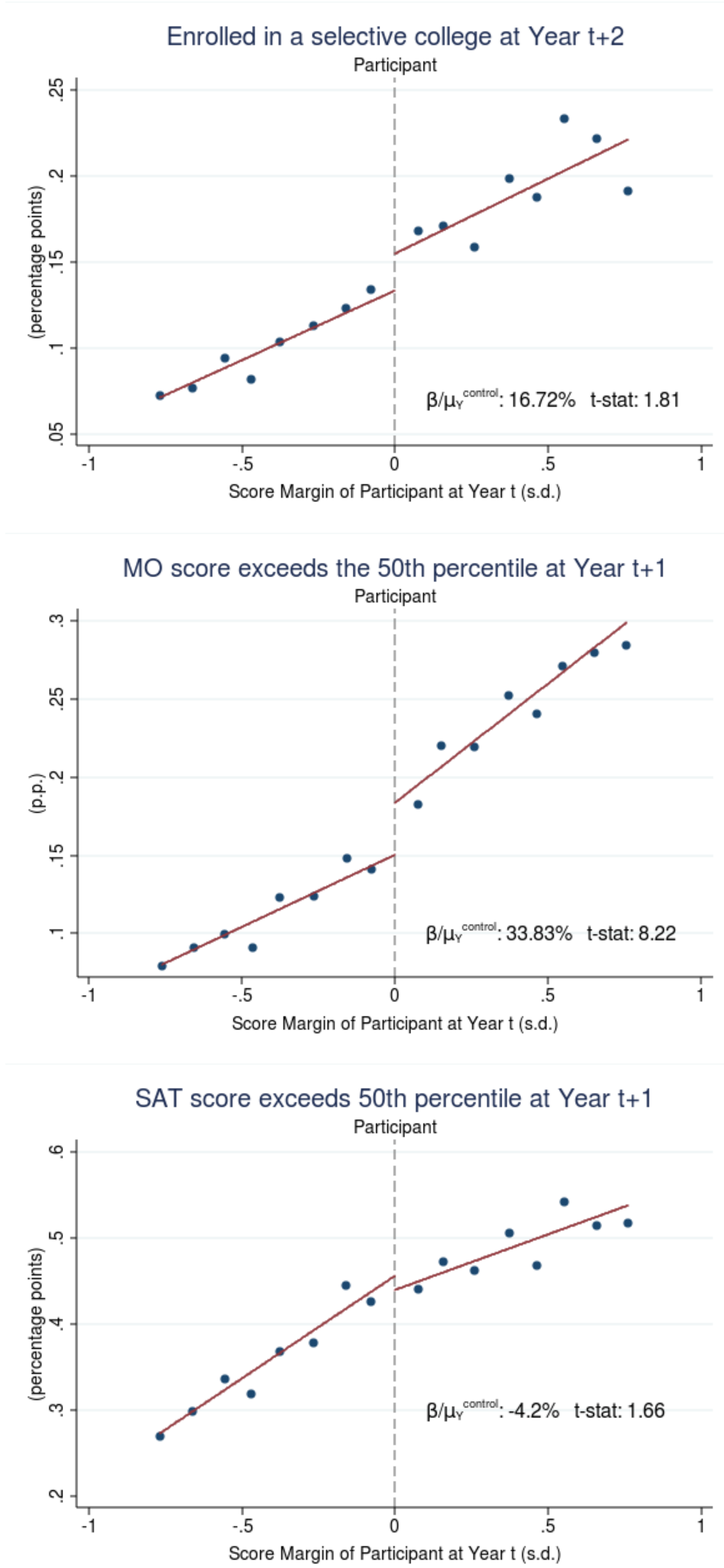


(d) School



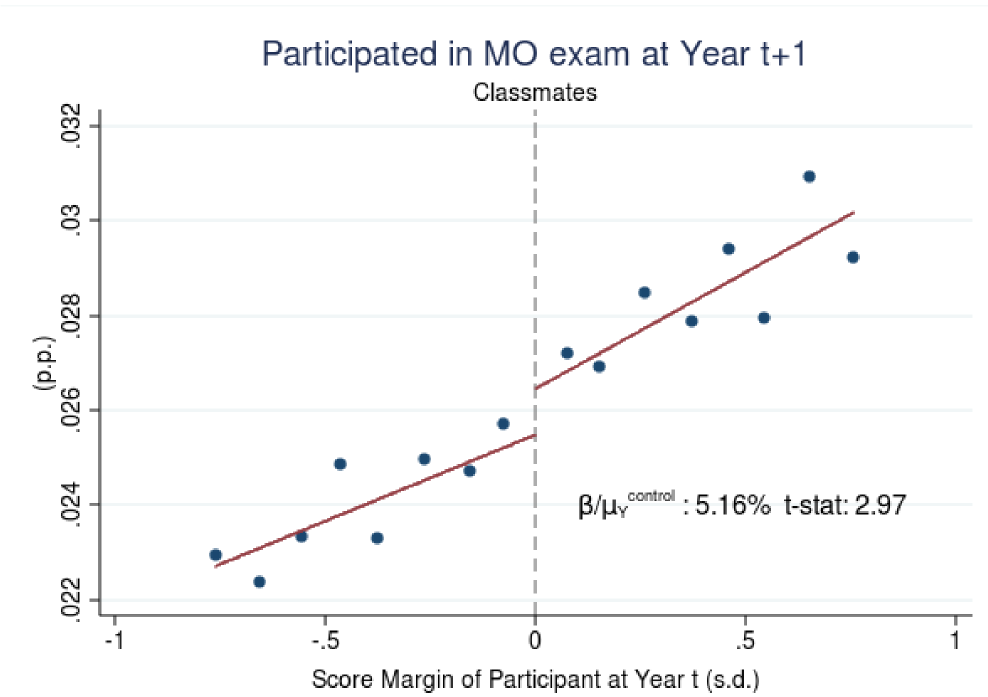
This figure plots pre-award student's characteristic variables as a function of score margin of participant at year t (running variable). It report the mean of each outcome for each of the bins. I report bins for every .1 standard deviation of the running variable around the award threshold. This forces the bins on the right of cutoff to only use observations at the right (and likewise for the the left). All variables were residualized only by grade fixed effect. Panel A and B reports variables at the classmates level. In panel A, the y-axis reports the classmates' score in the MO at Year t. In panel B, the y-axis reports whether the classmates participated in the MO at Year t. Panel C and D reports school level variables. In Panel C, y-axis reports the share of 12th graders in the participant's school who participate in the SAT. In Panel D, y-axis reports the number of awards to the school prior to the award. In each figure I report the corresponding regression result: The estimated β from equation 1 (including only grade fixed effect as control) divided by the control group mean of the corresponding outcome variable, as well as the corresponding t-statistics.

Figure 5: Student's Post-Award Educational Outcomes (Participant)



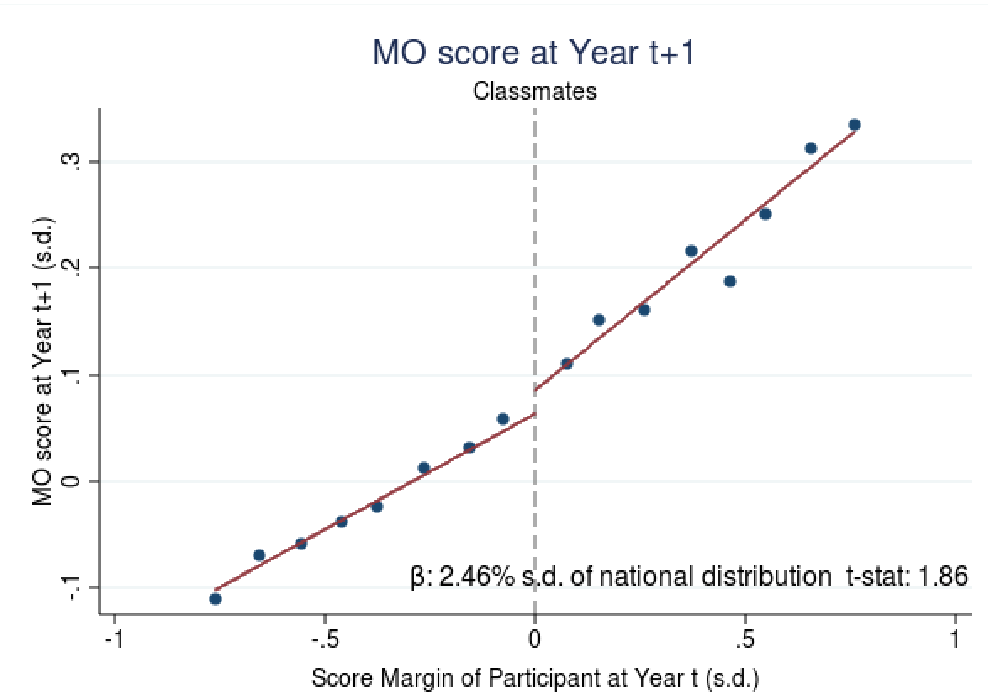
This figure plots post-award participant's educational outcomes variables as a function of score margin of the participant at year t (running variable). See notes on Figure 4 for how observations are grouped in bins. Top figure reports an outcome which is equal to 1 if the student enrolled at Year $t+2$ in a selective college that exceeded the 70th selectivity percentile. Middle figure reports an outcome which is equal to 1 if the MO score at Year $t+1$ exceeded the 50th percentile of the national distribution. Bottom figure reports an outcome which is equal to 1 if the SAT score at Year $t+1$ exceeded the 50th percentile of the national distribution. All variables are well defined (1 or 0) for the entire sample.

Figure 6: Participation in Math Olympiad Exam at $t+1$ (Classmates)



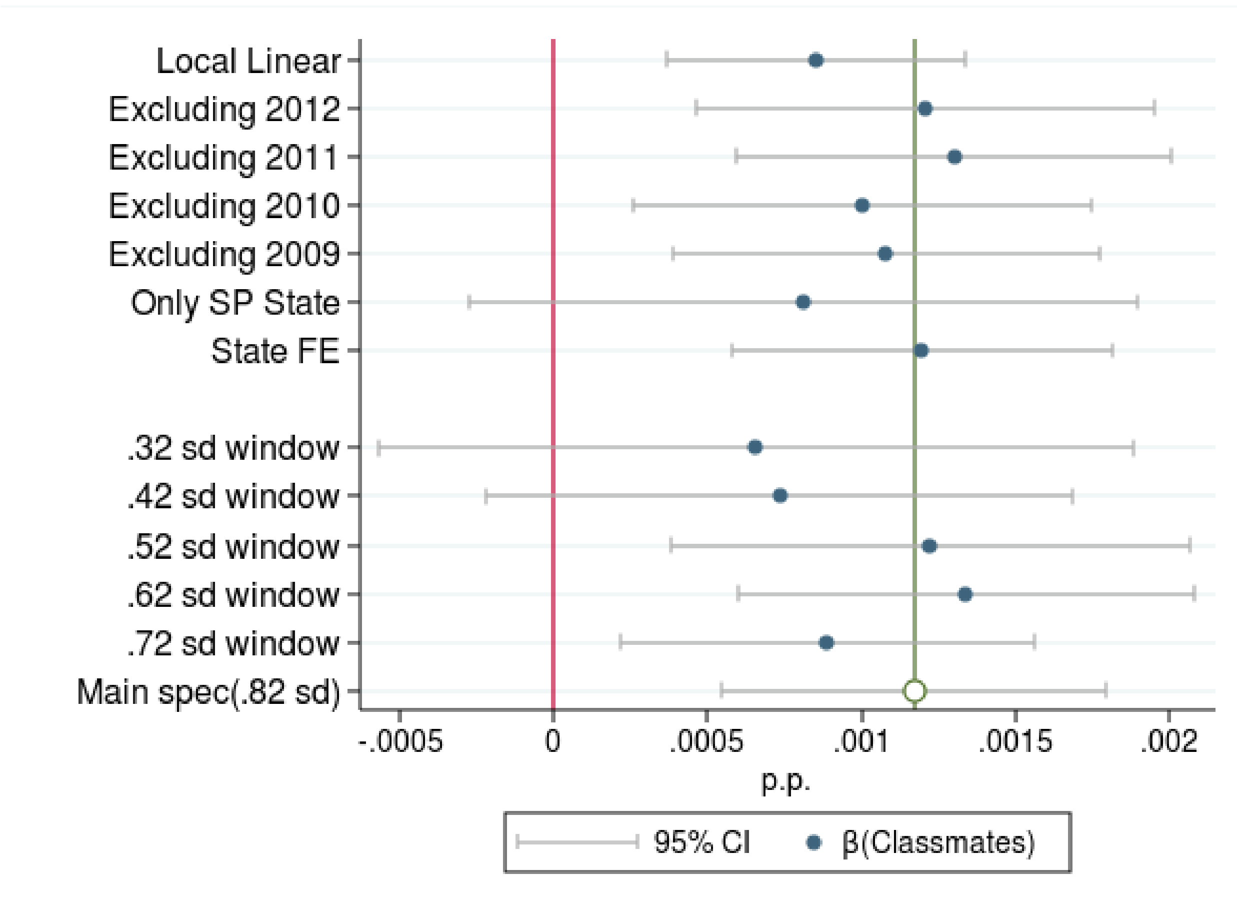
Notes: This figure plots Classmates' participation in the Math Olympiad at year $t+1$ as a function of score margin of the participant at year t (running variable). See notes on Figure 4 for how observations are grouped in bins. The y-axis reports whether the classmates participated in the MO at Year $t+1$. I report the corresponding regression result: The estimated β from equation 2 divided by the control group mean of the outcome variable, as well as the corresponding t-statistics. Outcome variable is well defined (1 or 0) for the entire sample.

Figure 7: Math Olympiad Score at $t + 1$ (Classmates)



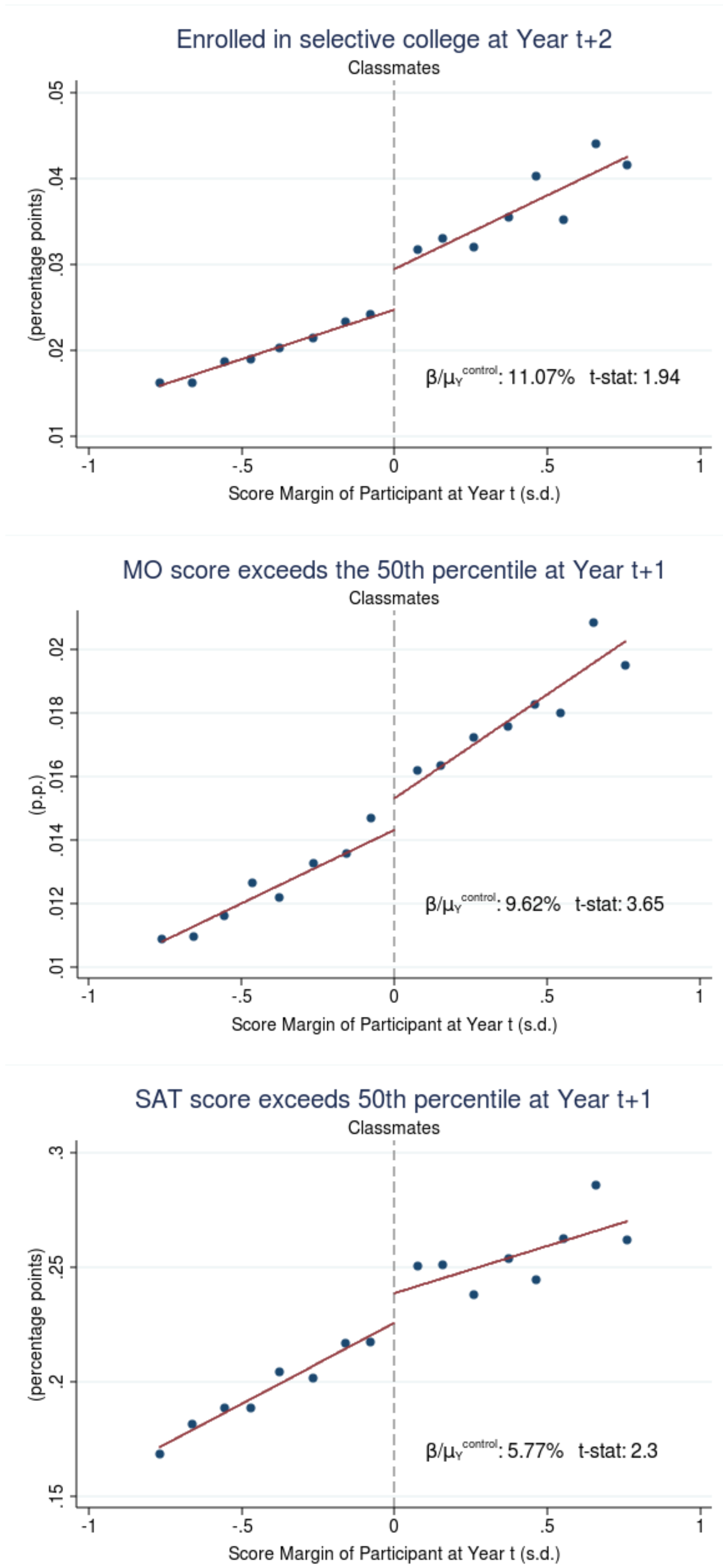
Notes: This figure plots classmate's score in the Math Olympiad at year $t + 1$ (in standard deviation units of national distribution) as a function of score margin of the participant at year t (running variable). See notes on Figure 4 for how observations are grouped in bins. The y-axis reports classmates' score in the Math Olympiad at year $t + 1$ (in standard deviation units of national distribution). I report the corresponding regression result: The estimated β from equation 2, as well as the corresponding t-statistics.

Figure 8: Sensitivity to Alternative Specifications (Classmates)



Notes: This graph report impact of award using alternative specifications. Outcome variable in all specification is equal to 1 if classmate's MO score at Year $t+1$ exceeds the 50th percentile of national score distribution (0 otherwise). Outcome variable is well defined (1 or 0) for the entire sample. Main spec (.82 s.d.) reports β estimated from equation **??** around a bandwidth of $h = .82$. Local linear implements a non-parametric local linear estimator. Excluding 2012, 2011, 2010 and 2009 estimate the main specification, excluding each of them a each of the MO cohort-years. Only SP state estimate the impact only for the state of Sao Paulo. State FE estimate the main specification with 27 dummies for the Brazilian states. The remaining estimate the main specification but varying the size of the bandwidth.

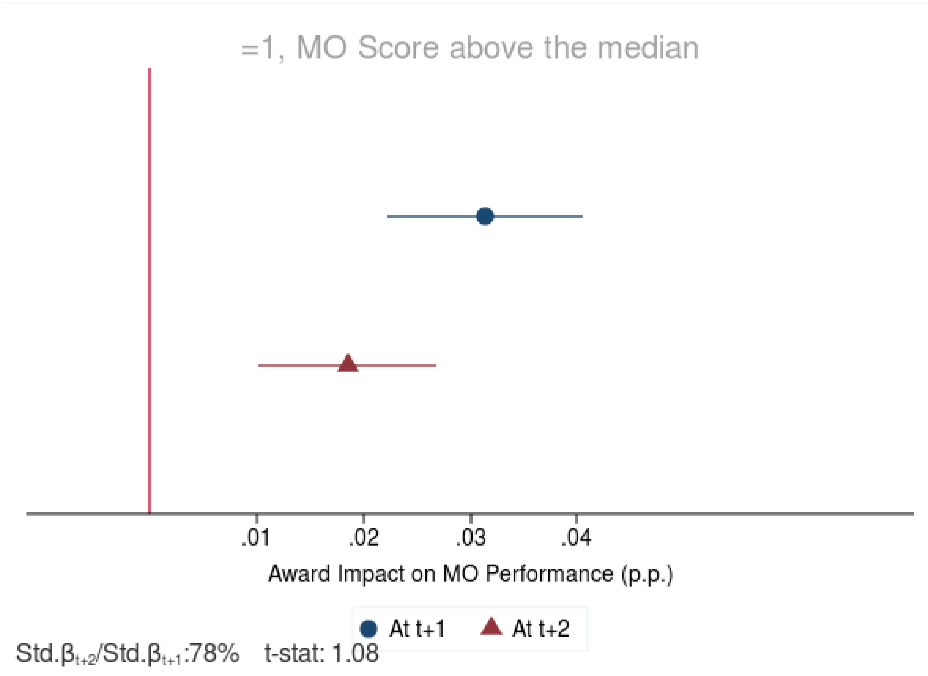
Figure 9: Student's Post-Award Educational Outcomes (Classmates)



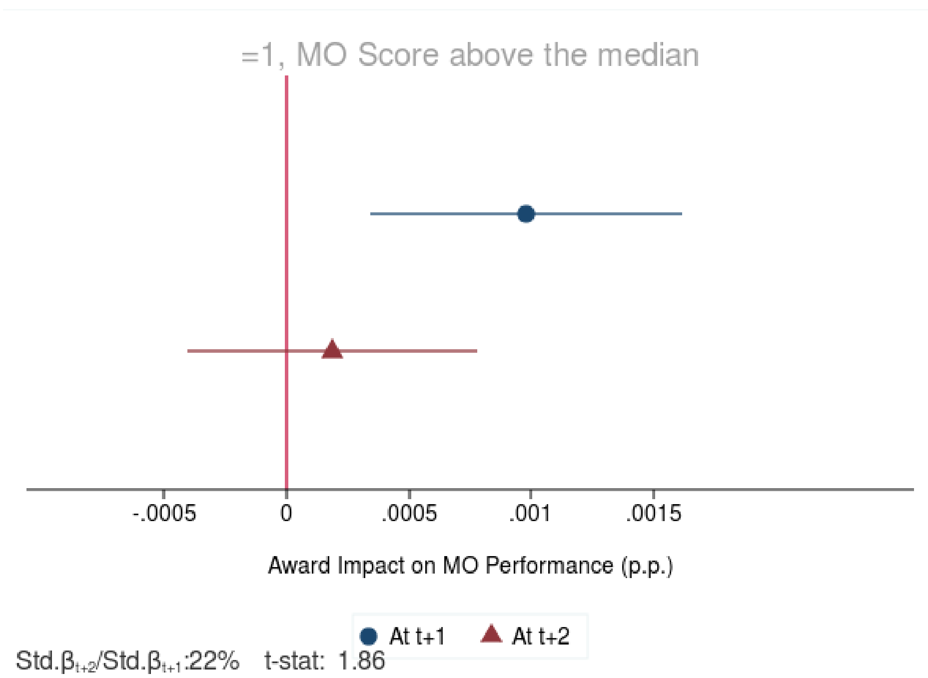
This figure plots post-award classmates' educational outcomes variables as a function of score margin of the participant at year t (running variable). See notes on Figure 4 for how observations are grouped in bins. Top figure reports an outcome which is equal to 1 if the student enrolled at Year $t + 2$ in a selective college that exceeded the 70th selectivity percentile. Middle figure reports an outcome which is equal to 1 if the MO score at Year $t + 1$ exceeded the 50th percentile of the national distribution. Bottom figure reports an outcome which is equal to 1 if the SAT score at Year $t + 1$ exceeded the 50th percentile of the national distribution. All variables are well defined (1 or 0) for the entire sample.

Figure 10: Award Impact assigned at Year t on MO performance at $t+1$ and $t+2$

(a) Participant

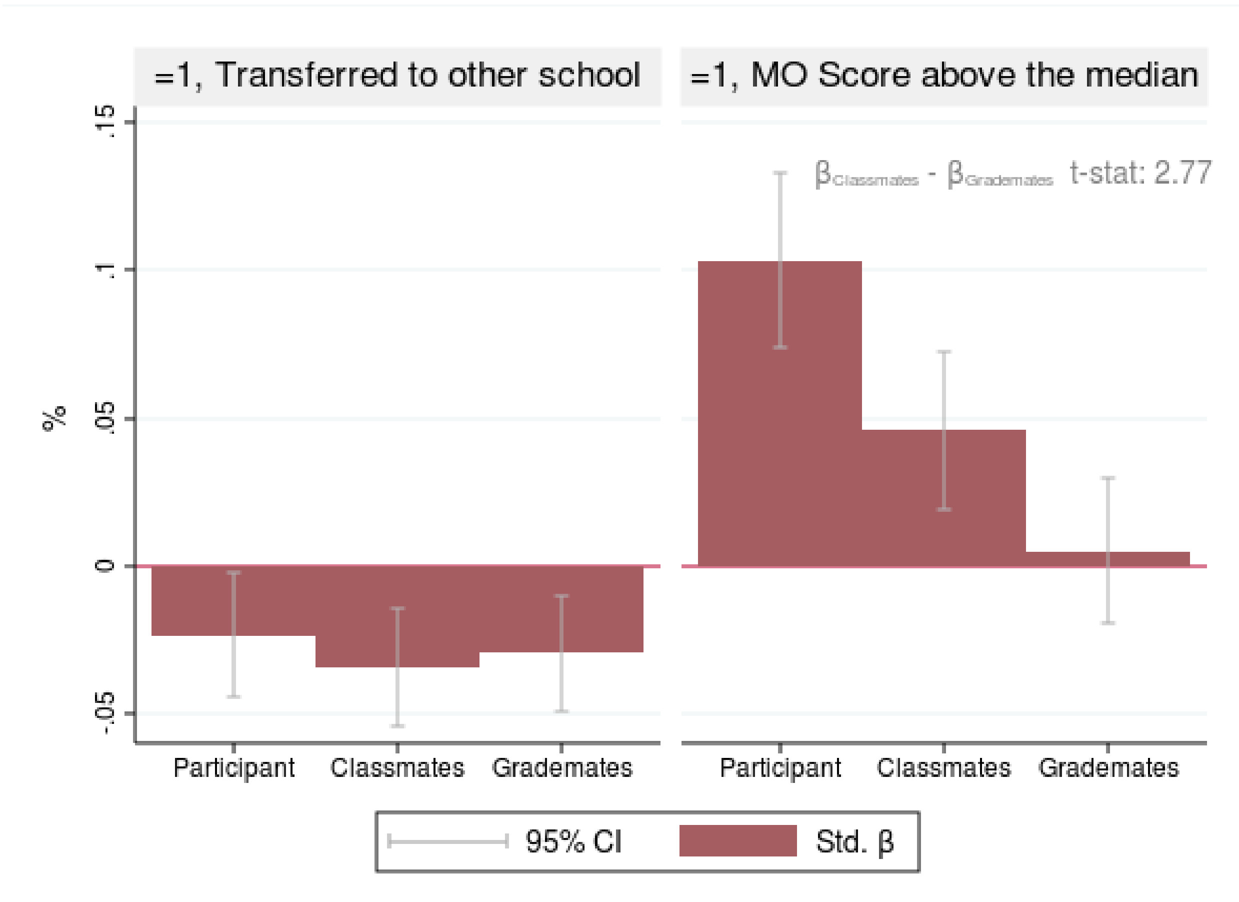


(b) Classmates



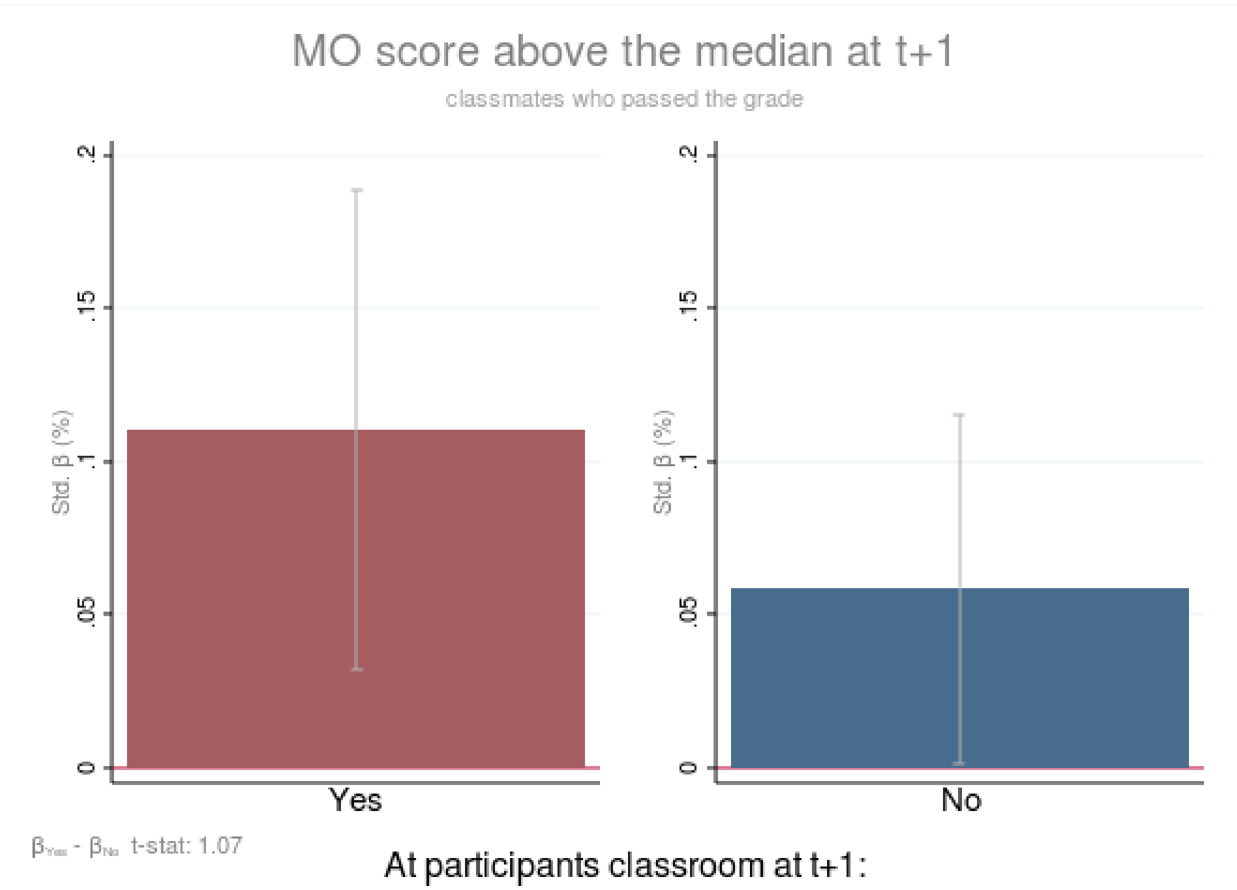
Notes: Sample restricted to be a balanced sample: includes 6^{th}-10^{th} grades, 2009-2012 (excludes 11th grade). Restriction imposed for keeping the same sample in $t+1$ and $t+2$ specifications. Panel A reports the estimated β from equation 1 for the participant. Panel B, reports equation 2 for the classmates. The outcome is equal to 1 if the student's MO score exceeds the 50th percentile of national score distribution at different years (0 otherwise). Outcome variable is well defined (1 or 0) for the entire sample. In each of the figures, the blue circle refers to the outcome assessed at year $t+1$, the red triangle refers to the outcome assessed at year $t+2$. At the bottom of the figures I report the ratio between Std. $beta_{t+1}$. The definition of Std. β_{t+1}=$\beta^{Y_{t+1}}/\mu^{control}_{Y_{t+1}}$. The t-stat refers to Wald test for whether Std. $beta_{t+1}$ is statistically equal to Std. $beta_{t+2}$ For the corresponding regression table see Table **??**.

Figure 11: Impact of award assigned at t on School Choice and MO Performance at $t + 1$



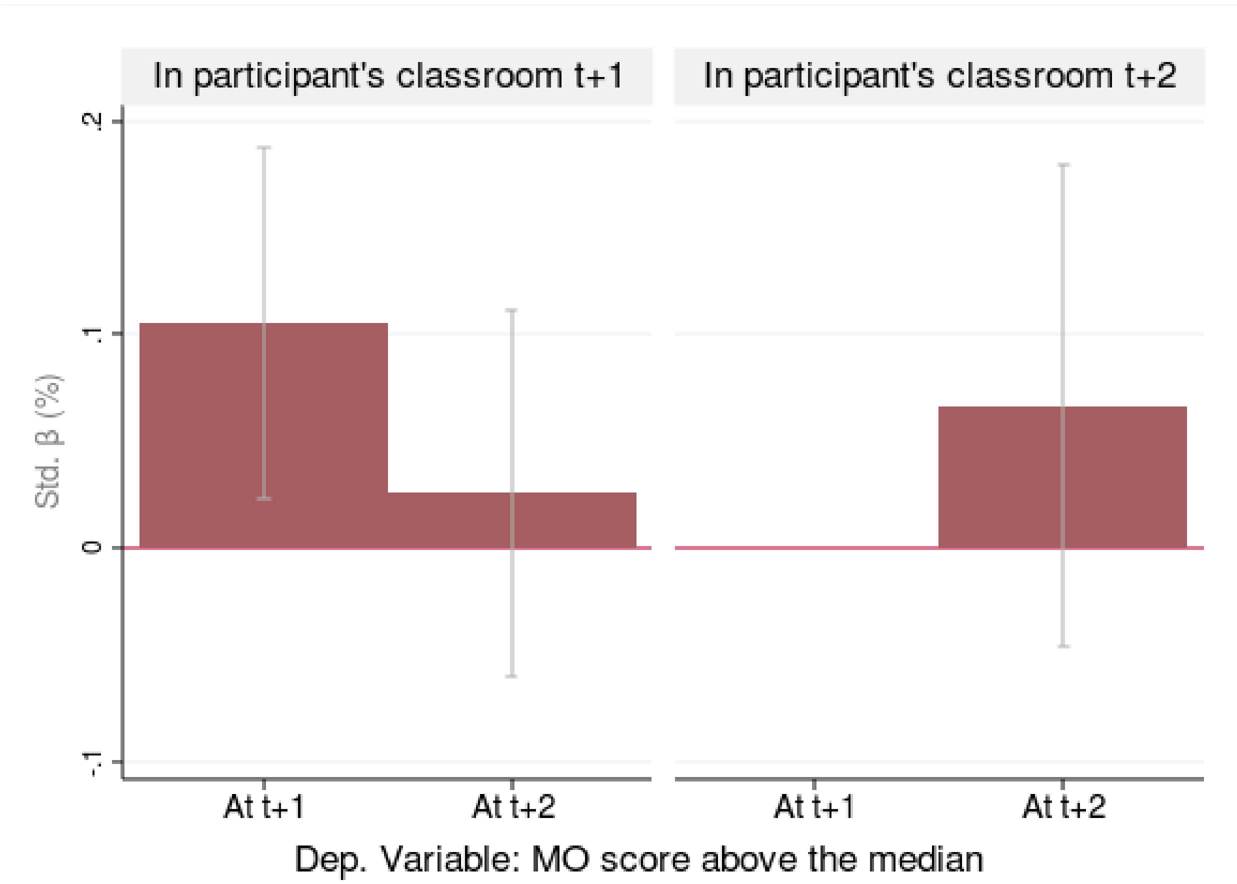
Notes: Outcome on the left is equal to 1 if the students transfer to another school. Outcome on the left is equal to 1 if MO score exceeds the 50th percentile of national distribution. All regressions estimated at the classroom level but for different samples. Classmates regression outcome is the mean of the outcome for all students in the participant's classroom excluding the participant herself. Grade-mates' regression outcome is the mean of the outcome for all students in the participant's grade excluding the participant's classroom. I explain in the text why it is necessary to take the mean rather than estimating at the individual level. The corresponding regression is reported in Table 12

Figure 12: Impact of award on MO performance at $t+1$ by Classroom assignment at $t+1$ (Classmates)



Notes: This figure reports heterogeneous impact by classroom assignment at $t+1$. The outcome is equal to 1 if the student's MO score at Year $t+1$ exceeds the 50th percentile of national score distribution (0 otherwise). Outcome variable is well defined (1 or 0) for the entire sample. In red, it reports the impact of the award on classmates at t who continue in the participant's classroom at $t+1$, in blue the impact of the award on those classmates at t who do not continue in the participant's classroom at $t+1$. The corresponding regression is reported in Table 13

Figure 13: Impact of award on MO performance at $t+1$ and $t+2$ for students that continue classmates with the participant (Classmates)



Notes: This figure reports heterogeneous impact by classroom assignment at years $t+1$, figure on the left, and $t+2$, figure on the right. The outcome is equal to 1 if the student's MO score exceeds the 50th percentile of national score distribution (0 otherwise), first and third bar refers to outcome assessed at $t+1$, and second and forth bar refers to outcome assessed at $t+2$. Outcome variable is well defined (1 or 0) for the entire sample. The corresponding regression is reported in Table 14

Table 1: Summary Statistics

Panel A		RD sample	Full sample
% of schools in quartiles of the test score distribution of all schools	Q1	0.10	0.18
	Q2	0.20	0.24
	Q3	0.29	0.25
	Q4	0.34	0.22
# of students enrolled in the school		780.07	738.51
% of students participating in SAT		0.52	0.49
Number of award in past 2 years		4.15	2.88
# of classrooms		170,335	688,655

Panel B	RD Sample	
	Participant	Classmates
% female	0.46	0.52
% white	0.61	0.52
% that participate in MO exam	0.13	0.02
Among MO takers, % that score above the median	0.84	0.51
% of SAT takers	0.80	0.55
Among SAT takers, % scoring above the median in SAT	0.80	0.40
Among SAT takers, % enrolled in top 30th selective college	0.28	0.11
# of students	170,335	5,114,922

Notes: This table report in Panel A, summary statistics for the RD sample vs Full sample and in Panel B, summary statistics of the participant and her classmates. In Panel A, first 4 lines report % of schools in each of the samples that are in each of the quartiles of the national score distribution. N of students enrolled in the school, is the total number of students at the year t% of students participating in SAT, is the share of 12th graders that participate in the SAT. Panel B, first two lines represent the gender and race of the student. The following are measures of students' performance measured at $t+1$ but all referring to the control group.

Table 2: Smoothness in Pre-Award Characteristics

RD bandwidth: h=.82

	All grades			11th grade		
	β	t-stat	$\mu^{control}$	β	t-stat	$\mu^{control}$
Panel A. School level	(1)	(2)	(3)	(4)	(5)	(6)
# of Medals and HM awards in the past 2 years	0.0454	0.52	3.565	0.1384	0.48	4.216
# of Honorable Mention awards in the past 2 years	0.0512	0.70	3.295	0.1159	0.48	3.913
North Region	0.0000	0.00	0.0669	-0.0072	0.96	0.0746
Northeast Region	0.0009	0.24	0.199	0.0042	0.35	0.249
Southeast Region	0.0012	0.21	0.462	-0.0154	0.99	0.413
South Region	0.0020	0.44	0.183	0.0032	0.25	0.173
Central west Region	-0.0041	1.32	0.0879	0.0153*	1.70	0.0904
=1, if school is managed by municipal government	0.0090*	1.80	0.308	-0.0020	0.48	0.0127
% of 12th graders participating in SAT	-0.0003	0.07	0.512	-0.0035	0.45	0.527
=1 if selective school	0.0017	0.89	0.0183	0.0044	0.56	0.0415
Average SAT score	0.0051	0.98	-0.285	0.0092	1.51	-0.282
Average 9th grade Prova Brasil score	-0.3162	1.25	495.6	-2.1905*	1.83	493.2
Total school enrollment	-1.5948	0.30	775.6	-1.6642	0.10	918.1
Rural school	-0.0008	0.29	0.0826	-0.0004	0.06	0.0417
Panel B. Classmates level						
Grade attainment at t	-0.0009	0.75	0.906	-0.0009	0.29	0.920
=1, if Participated at MO Exam at t	-0.0001	0.25	0.0243	0.0001	0.091	0.0211
=1, if MO score in top 30th percentile at t	0.0003	1.5	0.00382	-0.0005	0.714	0.00561
Female	0.0006	0.5	0.522	0.0034	0.872	0.571
White	0.0039	1.15	0.507	0.0004	0.041	0.487
Panel C. Participant level						
Grade attainment at t	-0.0018	1.13	0.972	0.0026	0.53	0.971
=1, if Participated at MO Exam at t-1	0.0027	0.55	0.131	0.0218*	1.85	0.0968
=1, if MO score in top 30th percentile at t-1	0.0023	0.64	0.0620	0.0139	1.34	0.0579
Female	-0.0016	0.28	0.474	-0.0112	0.70	0.419
White	0.0012	0.17	0.585	0.0077	0.38	0.545

Notes: This table report tests for smoothness in pre-award characteristics. 11th grade sample size: 21366; All grades sample size: 170,355. Column 1 and 4 reports β of main specification estimated with the bandwidth $h = .82$: $Y_{ij} = \alpha + \beta Award_j + \gamma_1 ScoreMargin_j + \gamma_2 Award_j \times ScoreMargin_j + X_j + \epsilon_{ij}$. The Y_{ij} are specified in each of the lines of the table and are at different level: school and participant and classmates level. The Column 2 and 5 report the t-statistics associated with the estimate β. Column 3 and 6 report the mean of the control group.

Table 3: Impact of Award on Performance Outcomes (Participant)

Panel A	Math Olympiad at Year t+1					
	Participated in MO	Probability of exceeding MO score percentiles of national distibution: 50th	60th	70th	80th	90th
	(1)	(2)	(3)	(4)	(5)	(6)
Award	0.0348***	0.0348***	0.0335***	0.0322***	0.0286***	0.0191***
	(0.0045)	(0.0044)	(0.0043)	(0.0041)	(0.0037)	(0.0030)
Students (obs.)	170,335	170,335	170,335	170,335	170,335	170,335
Dep. Variable control mean	0.128	0.107	0.0959	0.0793	0.0577	0.0281
Std. beta	0.272	0.325	0.349	0.406	0.496	0.680
Panel B	Tertiary Education at Year t+2					
	Enroll in tertiary education	Probability of attending a college that exceeds selectivity percentile: 50th	60th	70th	80th	90th
	(1)	(2)	(3)	(4)	(5)	(6)
Award	-0.0075	0.0038	0.0022	0.0224*	0.0195**	0.0134*
	(0.0152)	(0.0137)	(0.0129)	(0.0117)	(0.0099)	(0.0071)
Students (obs.)	21,346	21,346	21,346	21,346	21,346	21,346
Dep. Variable control mean	0.366	0.223	0.180	0.128	0.077	0.030
Std. beta	-2.05%	1.70%	1.23%	17.46%	25.28%	45.39%
Panel C	SAT at Year t+1					
	Participate in SAT	Probability of exceeding SAT score percentiles of national distibution: 50th	60th	70th	80th	90th
	(1)	(2)	(3)	(4)	(5)	(6)
Award	-0.0103	-0.0195	-0.0216	-0.0101	0.0179	0.0310**
	(0.0159)	(0.0161)	(0.0161)	(0.0159)	(0.0151)	(0.0121)
Students (obs.)	21,346	21,346	21,346	21,346	21,346	21,346
Dep. Variable control mean	0.8	0.642	0.573	0.464	0.313	0.121
Std. beta	-1.29%	-3.04%	-3.77%	-2.18%	5.72%	25.60%
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Bdw selection	h=.82					

Notes: Sample for Panel A includes all grades, sample for Panel B and C inlcudes only 11th graders. The table displays the award impact on participant performance using a regression discontinuty design specified at equation 1. The regressions are all estimated on a sample within $h = .82$ s.d. above and below the award threshold. Results for the other bandwidths are in the appendix. In addition to the $Award$ variable, the specification includes the following covariates (coefficients not reported): $Score_c$, $Award_c \times Score_c$. All columns include controls. The controls are: grade fixed effect, MO cohort-year fixed effect, indicator variables for each of the quartiles of national school quality distribution. Panel A reports the award impact on Math Olympiad performance at $t + 1$. In column 1, the outcome Participate in MO is equal to 1 if the student show up to the MO Exam at $t + 1$; Columns 2 to 6 report if the student score exceeded different percentiles of the MO national distribution. The outcome in Column 2, for example, is equal to 1 if the student score exceeded the 50th percentile of the national MO score distribution. Panel C, follows the same structure of outcomes but for the participation and performance in the SAT at $t + 1$ Panel B, report the impact on tertiary education enrollment. Column 1, Enroll in tertiary education is equal to 1, if the student enrolled in any tertiary education. Columns 2 up to 6, measure whether the student enroll in colleges with different degrees of selectivity. The outcome in column 2 for example is equal to 1 if the college the student enrolled exceeds the 50th percentile in terms of selectivity. All outcomes are well defined, assuming values 1 or 0, (not missing) for the entire sample. Levels of significance: $*$ 10%, $**$ 5%, and $***$ 1%

Table 4: Impact of Award assigned at Year t on Math Olympiad (MO) Performance at Year $t+1$ (Classmates)

Panel B. Classmates	Participated in MO exam at Year t+1			
	(1)	(2)	(3)	(4)
Award	0.0014***	0.0014***	0.0013***	0.0011**
	(0.0005)	(0.0005)	(0.0004)	(0.0004)
Students (obs.)	3,540,290	3,540,290	5,114,922	4,899,094
Classrooms (Clusters)	117,882	117,882	170,331	163,337
Dep. variable control mean	.024	.024	.024	.024
Bdw selection	h= .62 (Min)	h= .62 (Min)	h= .82 (Avg)	h= .79 (optimal)
Controls	No	Yes	Yes	Yes

Panel B. Classmates	MO score at Year t+1			
	(1)	(2)	(3)	(4)
Award	0.0362**	0.0409***	0.0293**	0.0367**
	(0.0166)	(0.0147)	(0.0124)	(0.0152)
Students (obs.)	89,872	89,872	127,331	84,033
Classrooms (Clusters)	54,213	54,213	77,191	50,554
Dep. variable control s.d.	.82	.82	.81	.82
Bdw selection	h= .62 (Min)	h= .62 (Min)	h= .82 (Avg.)	h= .57 (optimal)
Controls	No	Yes	Yes	Yes

Notes: The table displays award impact on classmates performance in the MO at $t+1$ using a regression discontinuity design specified at equation 2. The regressions are all estimated on a sample within h s.d. above and below the award threshold. I report various bandwidths of size h: column 1 and 2, $h = .62$; column 3, $h = .82$, column 4 $h = .79$. In addition to the $Award$ variable, the specifications include the following covariates (coefficients not reported): $Score_c$, $Award_c \times Score_c$. The models reported in columns 2, 3 and 4 contain controls. The controls are: grade fixed effect, MO cohort-year fixed effect, indicator variables for each of the quartiles of the national distribution of school quality distribution. Panel A report impact on *Participate in MO* which is equal to 1 if the student show up to the MO Exam at $t+1$. This outcomes is well defined, assuming values 1 or 0, (not missing) for the entire sample. Panel B reports award impact on MO score at $t+1$. Standard errors are clustered at the classroom level. Levels of significance: $*$ 10%, $**$ 5%, and $***$ 1%

Table 5: Impact of award on composition of students who Participate in MO exam at $t+1$ (Classmates)

Classmates	Std. Math+ELA scores (s.d.) at t-2		
	(1)	(2)	(3)
Award	-0.2936*	-0.2944*	-0.2727**
	(0.1625)	(0.1561)	(0.1295)
Students (obs.)	1,174	1,174	1,578
Classrooms (Clusters)	793	793	1,075
Dep. variable control s.d.	1.1	1.1	1.1
Bdw selection	h=.62	h=.62	h=.82
Controls	No	Yes	Yes
Sample Restriction: Students participated in MO at t+1	Yes	Yes	Yes

Notes: The table displays award impact on the composition of classmates participating in the MO exam at $t+1$ using a regression discontinuity design specified at equation 2. The regressions are all estimated on a sample within h s.d. above and below the award threshold. I report various bandwidths of size h: column 1 and 2, $h = .62$; column 3, $h = .82$. In addition to the $Award$ variable, the specifications include the following covariates (coefficients not reported): $Score_c$, $Award_c \times Score_c$. The model reported in columns 2 and 3 contains controls. The controls are: grade fixed effect, MO cohort-year fixed effect, indicator variables for each of the quartiles of the national distribution of school quality distribution. To get at change in composition of test MO participants, the sample is restricted to students who participate in the MO. The outcome variable is a standardized low-stakes test score assessed at $t-2$. This is only available for a sub-sample (11th graders, in the State of Sao Paulo). Standard errors are clustered at the classroom level. Levels of significance: $*$ 10%, $**$ 5%, and $***$ 1%.

Table 6: Impact of Award assigned at Year t on MO Performance at $t+1$ (Classmates)

	Math Olympiad at Year t+1					
	Participate in MO exam	Probability of exceeding MO score percentiles of national distibution				
		50th	60th	70th	80th	90th
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A						
Award	0.0013***	0.0012***	0.0011***	0.0008***	0.0006***	0.0002*
	(0.0004)	(0.0003)	(0.0003)	(0.0002)	(0.0002)	(0.0001)
Students (obs.)	5,114,922	5,114,922	5,114,922	5,114,922	5,114,922	5,114,922
Classrooms (clusters)	170331	170331	170331	170331	170331	170331
Bdw select	0.82	0.82	0.82	0.82	0.82	0.82
Panel B						
Award	0.0014***	0.0013***	0.0013***	0.0010***	0.0008***	0.0004**
	(0.0005)	(0.0004)	(0.0003)	(0.0003)	(0.0002)	(0.0001)
Students (obs.)	3,540,290	3,540,290	3,540,290	3,540,290	3,540,290	3,540,290
Classrooms (clusters)	117882	117882	117882	117882	117882	117882
Bdw select	0.62	0.62	0.62	0.62	0.62	0.62
Panel C						
Award	0.0011**	0.0009**	0.0013***	0.0008***	0.0006***	0.0003**
	(0.0004)	(0.0003)	(0.0003)	(0.0002)	(0.0002)	(0.0001)
Students (obs.)	4,899,094	4,439,637	3,540,290	5,631,938	4,171,519	3,672,852
Classrooms (clusters)	163337	147928	117882	187788	138796	122418
Bdw select	0.79	0.75	0.59	0.88	0.68	0.65
Control	Yes	Yes	Yes	Yes	Yes	Yes
Dep. Variable control mean	0.0239	0.0122	0.00969	0.00694	0.00431	0.00174
Std. beta	0.054	0.098	0.114	0.115	0.139	0.115

Notes: Sample includes 11^{th} graders only. The table displays the award impact on classmates Math Olympiad performance at $t+1$ using a regression discontinuity design specified at equation 2. The regressions are all estimated on a sample within h s.d. above and below the award threshold. Panel A, report the results for $h = .82$, Panel B report results for $h = .62$ and Panel C, for various bandwidths - the optimal bandwidth for each individual outcome. In addition to the $Award$ variable, the specification includes the following covariates (coefficients not reported): $Score_c$, $Award_c \times Score_c$. All columns include controls. The controls are: grade fixed effect, MO cohort-year fixed effect, indicator variables for each of the quartiles of national school quality distribution. In column 1, the outcome Participate in MO is equal to 1 if the student show up to the MO Exam at $t+1$; Columns 2 to 6 report if the student score exceeded different percentiles of the MO national distribution. The outcome in Column 2, for example, is equal to 1 if the student score exceeded the 50th percentile of the national MO score distribution. All outcomes are well defined, assuming values 1 or 0, (not missing) for the entire sample. Standard errors are clustered at the classroom level. Levels of significance: $*$ 10%, $**$ 5%, and $***$ 1%

Table 7: Impact of Award assigned at Year t on SAT Performance at $t+1$ (Classmates)

	SAT at Year t+1					
	Participate in SAT	Probability of exceeding SAT score percentiles of national distibution				
		50th	60th	70th	80th	90th
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A						
Award	0.0089	0.0092**	0.0085**	0.0086**	0.0046*	0.0019
	(0.0060)	(0.0046)	(0.0041)	(0.0035)	(0.0027)	(0.0016)
Observations	675,221	675,221	675,221	675,221	675,221	675,221
Classrooms (clusters)	21346	21346	21346	21346	21346	21346
Bdw selection	0.820	0.820	0.820	0.820	0.820	0.820
Panel B						
Award	0.0127*	0.0102*	0.0078	0.0078*	0.0039	0.0019
	(0.0072)	(0.0055)	(0.0049)	(0.0042)	(0.0032)	(0.0018)
Students (obs.)	471,656	471,656	471,656	471,656	471,656	471,656
Classrooms (clusters)	14917	14917	14917	14917	14917	14917
Bdw selection	0.620	0.620	0.620	0.620	0.620	0.620
Panel C						
Award	0.0138*	0.0085**	0.0088**	0.0086**	0.0035	0.0019
	(0.0070)	(0.0042)	(0.0039)	(0.0035)	(0.0029)	(0.0017)
Students (obs.)	485,727	816,077	736,985	675,221	585,723	585,723
Classrooms (clusters)	15373	25812	23323	21346	18499	18499
Bdw selection	0.652	0.967	0.902	0.814	0.763	0.773
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Dep. Variable control mean	0.55	0.22	0.17	0.11	0.06	0.02
Std. Beta	0.016	0.041	0.051	0.078	0.078	0.114

Notes: Sample includes 11^{th} graders only. The table displays the award impact on classmates SAT performance at $t+1$ using a regression discontinuity design specified at equation 2. The regressions are all estimated on a sample within h s.d. above and below the award threshold. Panel A, report the results for $h = .82$, Panel B report results for $h = .62$ and Panel C, for various bandwidths - the optimal bandwidth for each individual outcome. In addition to the $Award$ variable, the specification includes the following covariates (coefficients not reported): $Score_c$, $Award_c \times Score_c$. All columns include controls. The controls are: grade fixed effect, MO cohort-year fixed effect, indicator variables for each of the quartiles of national school quality distribution. In column 1, the outcome *Participate in SAT* is equal to 1 if the student participated in the SAT at $t+1$; Columns 2 to 6 report if the student score exceeded different percentiles of the SAT national distribution. The outcome in Column 2, for example, is equal to 1 if the student score exceeded the 50th percentile of the national SAT score distribution. All outcomes are well defined, assuming values 1 or 0, (not missing) for the entire sample. Standard errors are clustered at the classroom level. Levels of significance: $*$ 10%, $**$ 5%, and $***$ 1%

Table 8: Impact of Award assigned at Year t on Educational Outcomes at $t+1$ (Classmates)

Classmates		(1)		(2)		(3)		LHS control	
	summary measure (s.d)	0.0186 *	(0.0095)	0.015 *	(0.0081)			μ	β/μ
MO	Score in top 30th percentile	0.0008	(0.0010)	0.0004	(0.0009)	0.0004	(0.0009)	1%	4%
	Participated in MO exam	0.0022	(0.0015)	0.0016	(0.0013)	0.0013	(0.0013)	2%	7%
	Qualified to MO	0.0010	(0.0024)	-0.0001	(0.0020)	-0.0008	(0.0022)	6%	0%
SAT	Score in top 30th percentile	0.0078 *	(0.0042)	0.0086 **	(0.0035)	0.0086 **	(0.0035)	11%	8%
	Score in top 50th percentile	0.0112 *	(0.0059)	0.0103 **	(0.0050)	0.0103 **	(0.0050)	27%	4%
	Participated in SAT	0.0127 *	(0.0072)	0.0089	(0.0060)	0.0138 **	(0.0070)	55%	2%
Test Score	Std. Math+ELA scores (s.d.)	0.0129	(0.0358)	0.0133	(0.0301)	0.0128	(0.0321)		1%
School progress	grade attainment	0.0043	(0.0058)	0.0071	(0.0049)	0.0055	(0.0047)	78%	1%
	no dropout	0.0036	(0.0037)	0.0029	(0.0031)	0.0024	(0.0031)	89%	0%
Bandwidth selection		h=.62		h=.82		(.62 < h < .89)			

Notes: Reports β from main specification specified at equation 2. Number of clusters for test score specification is 2717, for the remaining (MO, SAT and Progress in school) is 21346. Test score comes from SARESP only availaable for the State of Sao Paulo. Include controls: Grade FE, MO cohort FE and Quartile of school quality. Standard errors are clustered at the classroom level. Levels of significance: $*$ 10%, $**$ 5%, and $***$ 1%

Table 9: Impact of Award on Summary Measure at t+1 by classmates pre-award test score performance (Classmates)

	Summary measure at t+1			
Award	-0.0264	-0.0098	-0.0406 *	-0.0313
	(0.0263)	(0.0272)	(0.0237)	(0.0238)
Award x Above Median	0.0852 **		0.0552	
	(0.0429)		(0.0379)	
Award x in Top Quartile		0.111 **		0.079 *
		(0.0556)		(0.0477)
linear combination: coef.	0.0588	0.1012 *	0.0146	0.0477
linear combination: s.e.	(0.0429)	(0.0549)	0.032444	0.047534
% of pop in each subgroup	57%	30%	56%	29%
Bandwidth selection	0.62	0.62	0.82	0.82
Students (Obs.)	32000	32000	43349	43349
Classrooms (Clusters)	2083	2083	2854	2854
Sample restriction	11th grade sample			

Notes: Sample includes 11^{th} graders only. The table displays heterogeneous effects of the award impact on the summary measure at $t+1$ by pre-award score performance. The specification is equivalent to equation 1 and includes full set of interactions with pre-award score. Please see Table 8 for the individual outcomes that compose the summary measure - it includes measures of progress in school, standardized score, SAT and Math Olympiad all measured at $t+1$. The pre-award score used is the standardized Prova Brasil Exam at $t-2$

Table 10: Impact of Award assigned at Year t on Tertiary Education at $t+2$ (Classmates)

	Enroll in tertiary education	Probability of attending a college that exceeds selectivity percentile				
		50th	60th	70th	80th	90th
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A						
Award	0.0073**	0.0040*	0.0038*	0.0031*	0.0027**	0.0020***
	(0.0037)	(0.0024)	(0.0020)	(0.0016)	(0.0012)	(0.0007)
Students (obs.)	675,221	675,221	675,221	675,221	675,221	675,221
Classrooms (clusters)	21346	21346	21346	21346	21346	21346
Bdw selection	0.820	0.820	0.820	0.820	0.820	0.820
Panel B						
Award	0.0044	0.0023	0.0030	0.0024	0.0015	0.0017**
	(0.0044)	(0.0028)	(0.0024)	(0.0019)	(0.0014)	(0.0008)
Students (obs.)	471,656	471,656	471,656	471,656	471,656	471,656
Classrooms (clusters)	14917	14917	14917	14917	14917	14917
Bdw selection	0.620	0.620	0.620	0.620	0.620	0.620
Panel C						
Award	0.0045	0.0041*	0.0040**	0.0029*	0.0025**	0.0020**
	(0.0034)	(0.0023)	(0.0019)	(0.0016)	(0.0012)	(0.0008)
Students (obs.)	816,077	705,911	790,612	736,985	736,985	585,723
Classrooms (clusters)	25812	22321	25002	23323	23323	18499
Bdw selection	0.976	0.866	0.963	0.916	0.873	0.767
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Dep. Variable control mean	0.158	0.062	0.044	0.028	0.015	0.005
Std. beta	0.046	0.065	0.086	0.111	0.186	0.428

Notes: Sample includes 11^{th} graders only. The table displays the award impact on classmates enrollment in tertiary education at $t+2$ using a regression discontinuity design specified at equation 1. The regressions are all estimated on a sample within h s.d. above and below the award threshold. Panel A, report the results for $h = .82$, Panel B report results for $h = .62$ and Panel C, for various bandwidths - the optimal bandwidth for each individual outcome. In addition to the $Award$ variable, the specification includes the following covariates (coefficients not reported): $Score_c$, $Award_c \times Score_c$. All columns include controls. The controls are: grade fixed effect, MO cohort-year fixed effect, indicator variables for each of the quartiles of national school quality distribution. In column 1, the outcome *Enroll in tertiary education* is equal to 1 if the student enrolled in tertiary education at $t + 2$; Columns 2 to 6 report if the student enrolled in a college which exceeded the different percentiles of the degrees of selectivity (selectivity is defined by the average SAT of students enrolled in that college). The outcome in Column 2, for example, is equal to 1 if the student enrolled in a college which exceeded the 50th percentile of degree of selectivity. All outcomes are well defined, assuming values 1 or 0, (not missing) for the entire sample. Standard errors are clustered at the classroom level. Levels of significance: $*$ 10%, $**$ 5%, and $***$ 1%

Table 11: Heterogeneity of award impact on classroom Assignment at Year $t+1$ by pre-award performance

Panel A. Classmates	=1, if student is at participant's classroom at t+1			
	(1)	(2)	(3)	(4)
Award	0.0084**	0.0090**	0.0086**	0.0084**
	(0.0040)	(0.0040)	(0.0040)	(0.0040)
Award x Qualifying to MO at t		-0.0123**		
		(0.0057)		
Award x Participated in MO Exam at t			-0.0070	
			(0.0068)	
Award x Score exceeded 70th percentile at t				-0.0030
				(0.0122)
Students (obs.)	4,164,486	4,164,486	4,164,486	4,164,486
Classrooms (Clusters)	170,232	170,232	170,232	170,232
Dep. variable control mean	.5044	.5044	.5044	.5044
Bdw selection	.82	.82	.82	.82
Linear combination:β		-.003233	.001689	.005386
Linear combination: s.e.		.006698	.007648	.01267
Controls	Yes	Yes	Yes	Yes
Sample Restriction: Student passed the grade	Yes	Yes	Yes	Yes

Notes:The table displays heterogeneous effects of the award impact on the summary measure at $t+1$ by pre-award performance in the MO. The specification is equivalent to equation 1 and includes full set of interactions with pre-award performance. The regressions are all estimated on a sample within $h = .82$ s.d. above and below the award threshold. All columns include controls. The controls are: grade fixed effect, MO cohort-year fixed effect, indicator variables for each of the quartiles of national school quality distribution. The outcome is whether the student (participant's classmate at t) was assigned to the participant's classroom at $t+1$. Heterogeneous analysis based 3 different measures of student pre-award performance. In column 2, Qualifying to MO at t is equal to 1 if the student qualified for the 2nd phase of the MO. In column 3, Participated in MO exam at t, is equal to 1 if the student show up to the exam at t (and 0 otherwise). In column 4, Score exceeded 70th percentile at t, is equal to 1 if the student score exceeded the 70th percentile (and 0 otherwise). Standard errors are clustered at the classroom level. Levels of significance: $*$ 10%, $**$ 5%, and $***$ 1%

Table 12: Impact of Award assigned at Year t on School Choice and MO performance at $t+1$

	Transfer to other school		
	(1) Participant	(2) Classmates	(3) Grademates
Award	-0.0092**	-0.0089***	-0.0074***
	(0.0042)	(0.0026)	(0.0025)
Classrooms (Clusters)	148,705	148,704	148,705
Dep. Variable Mean	.19	.21	.22
Bdw selection	.82	.82	.82
Controls	Yes	Yes	Yes
	=1, if MO score is above the median		
	(1) Participant	(2) Classmates	(3) Grademates
Award	0.0321***	0.0012***	0.0001
	(0.0047)	(0.0004)	(0.0002)
Classrooms (Clusters)	148,705	148,705	148,705
Dep. Variable Mean	.11	.013	.011
Bdw selection	.82	.82	.82
Controls	Yes	Yes	Yes

Notes: The specification is equivalent to equation 1. The regressions are all estimated on a sample within $h = .82$ s.d. above and below the award threshold. All columns include controls. The controls are: grade fixed effect, MO cohort-year fixed effect, indicator variables for each of the quartiles of national school quality distribution. All regressions estimated at the classroom level. Column 1, refers to outcome for the participant. In Column 2 the outcome refers to the classmates. Since it is estimated at the classroom level, the outcome used is the average of each variable (transfer to school or performance in MO) for the participant's classroom excluding the participant herself. In Column 3 the outcome refers to the grade-mates (excluding classmates). Since it is estimated at the classroom level, the outcome used is the average of each variable (transfer to school or performance in MO) for grade-mates excluding the participant's classroom. Estimating at the classroom level was necessary in order to count all grade-mates no matter if the student was sometimes grade-mates of a barely winner and sometimes of a barely loser. I explain in detail in the text. Standard errors are clustered at the classroom level. Levels of significance: $*$ 10%, $**$ 5%, and $***$ 1% .

Table 13: Impact of Award assigned at Year t by Classroom Assignment at $t+1$

Panel A. Classmates	MO score is above the median	
	(1)	(2)
Award	0.0006**	0.0009**
	(0.0003)	(0.0004)
Award x at participant's classroom at t+1	0.0010	
	(0.0007)	
Award x at participant's classroom at t+1		0.0008
		(0.0007)
Students (obs.)	5,114,922	4,164,486
Classrooms (Clusters)	170,331	170,232
Dep. variable control mean	.01223	.01487
Bdw selection	.82	.82
Linear combination:β	.001597	.001643
Linear combination: s.e.	.0005966	.0005959
Controls	Yes	Yes
Sample Restriction: Student passed the grade	No	Yes

Notes: The table displays heterogeneous effects of the award impact on the summary measure at $t+1$ by whether the student continue to be classmates' of the participant at $t+1$. The specification is equivalent to equation 1 and includes full set of interactions with "at participant's classroom at $t+1$". The regressions are all estimated on a sample within $h = .82$ s.d. above and below the award threshold. All columns include controls. The controls are: grade fixed effect, MO cohort-year fixed effect, indicator variables for each of the quartiles of national school quality distribution. The outcome is whether the student score in the MO at $t+1$ exceeded the 50th percentile. In column 1 and 2, both use the same variable for heterogeneity analysis (whether the student continue to be classmates' of the participant at $t+1$). Column 2 is analogous with column 1, but restricts the sample to include only students who pass the grade. Standard errors are clustered at the classroom level. Levels of significance: $*$ 10%, $**$ 5%, and $***$ 1% .

Table 14: Impact of Award assigned at Year t by Classroom Assignment at $t+1$ and $t+2$

Panel A. Classmates	MO score is above the median			
	(1)	(2)	(3)	(4)
	at t+1	at t+2	at t+1	at t+2
Award	0.0005	-0.0000	0.0014***	-0.0002
	(0.0005)	(0.0005)	(0.0005)	(0.0004)
Award x at participant's classroom at t+1	0.0012	0.0004		
	(0.0008)	(0.0008)		
Award x at participant's classroom at t+2			-0.0006	0.0011
			(0.0009)	(0.0009)
Students (obs.)	3,118,997	3,118,997	3,118,997	3,118,997
Classrooms (Clusters)	148,775	148,775	148,775	148,775
Dep. variable control mean	.01587	.01416	.01587	.01416
Bdw selection	.82	.82	.82	.82
Linear combination:β	.001677	.0003654	.0007434	.0009462
Linear combination: s.e.	.0006685	.0006181	.0008113	.0008185
Controls	Yes	Yes	Yes	Yes
Sample Restriction: balanced panel	Yes	Yes	Yes	Yes

Notes: The table displays heterogeneous effects of the award impact on the performance in the MO at $t+1$ by classroom assignment at $t+1$ and $t+2$. The specification is equivalent to equation 1 and includes full set of interactions with "at participant's classroom at $t+1$". The regressions are all estimated on a sample within $h = .82$ s.d. above and below the award threshold. All columns include controls. The controls are: grade fixed effect, MO cohort-year fixed effect, indicator variables for each of the quartiles of national school quality distribution. Columns 1 and 2, both use the same variable for heterogeneity analysis (whether the student continue to be classmates' of the participant at $t+1$). In column 1, the outcome is whether the student score in the MO at $t+1$ exceeded the 50th percentile, and in column 2, the same Math Olympiad performance outcome assessed at $t+2$. Columns 3 and 4, both use the same variable for heterogeneity analysis (whether the student continue to be classmates' of the participant at $t+2$). In column 3, the outcome is whether the student score in the MO at $t+1$ exceeded the 50th percentile, and in column 4, the same Math Olympiad performance outcome assessed at $t+2$.Sample restricted to be balance accross all specifications. This implies excluding 2012 MO-cohort and 11th graders. Levels of significance: $*$ 10%, $**$ 5%, and $***$ 1% .

Table 15: Impact of Award assigned at Year t on Performance in MO at $t+1$ by classmates' social proximity to the participant (Classmates)

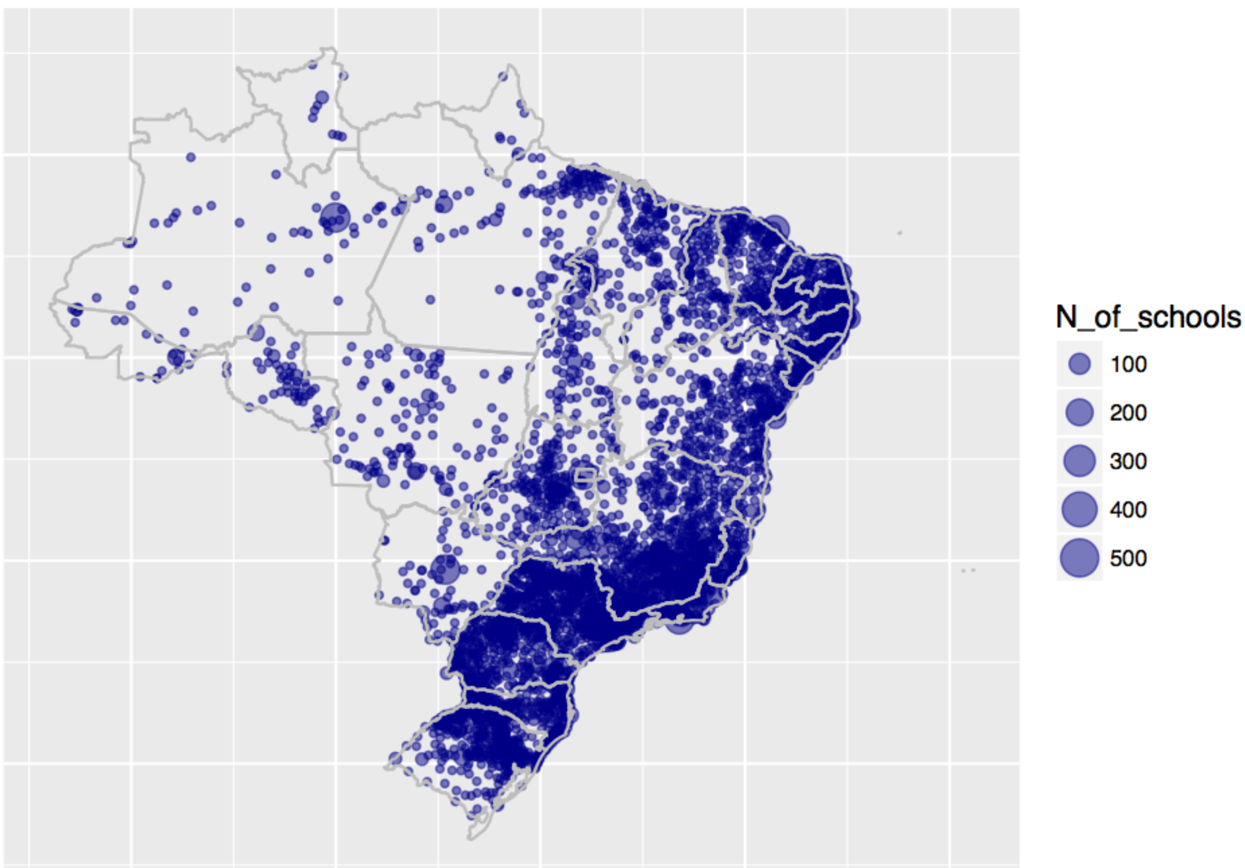
Classmates	MO score above the median at t+1					
	(1)	(2)	(3)	(4)	(5)	(6)
Award	0.0004	0.0012**	0.0004	0.0010**	0.0016**	0.0012***
	(0.0003)	(0.0005)	(0.0003)	(0.0004)	(0.0007)	(0.0004)
Award x Same gender as participant	0.0016***			0.0003		
	(0.0003)			(0.0006)		
Award x Same race as participant		0.0007*			0.0000	
		(0.0004)			(0.0008)	
Award x Same classroom as participant at t-1			0.0017***			0.0000
			(0.0003)			(0.0006)
Students (obs.)	5,114,922	2,511,911	4,815,437	5,114,922	2,511,911	4,815,437
Classrooms (Clusters)	170,331	105,319	165,697	170,331	105,319	165,697
Dep. variable control mean	.01223	.01374	.01251	.01223	.01374	.01251
Bdw selection	.82	.82	.82	.82	.82	.82
Linear combination:β	.001991	.001865	.002111	.001325	.001631	.001197
Linear combination: s.e.	.0003488	.000489	.0003809	.0004383	.000572	.0005268
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Full interaction	No	No	No	Yes	Yes	Yes

Notes: The table displays heterogeneous effects of the award impact on on students' performance in the Math Olympiad at $t+1$ by classmates' social proximity the participant (assessed prior to the award). Panel A report results for the participant, and in Panel B, for the classmates. The specification is equivalent to equation 2 and includes interactions with classmates' gender and race explained as follows. The specification in the first three columns include the additional variable: $Female$. The specification in the last three columns includes: $Female$ as well as its interaction with $Score_c$, $Award_c \times Score_c$. All are estimated on a sample within $h = .82$ s.d. above and below the award threshold. All columns include controls. The controls are: grade fixed effect, MO cohort-year fixed effect, indicator variables for each of the quartiles of national school quality distribution. Outcome variable is the same in all specifications and it is a binary variable equal to one if the student score exceeded 50th percentile of the MO national distribution (score above the median). In columns 1 and 4, the interaction is equal to one if the classmate and the participant is of the same gender. In columns 2 and 5, the interaction is equal to one if the classmate and the participant is of the same race. Standard errors are clustered at the classroom level. Levels of significance: $*$ 10%, $**$ 5%, and $***$ 1%

A Appendix

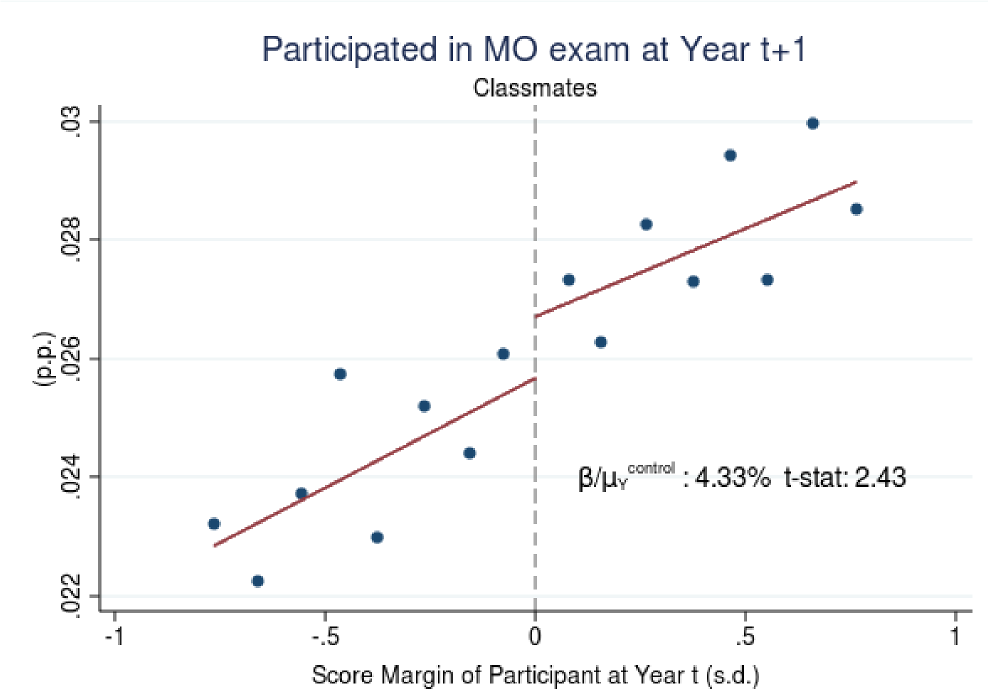
A.1 Additional Figures and Tables

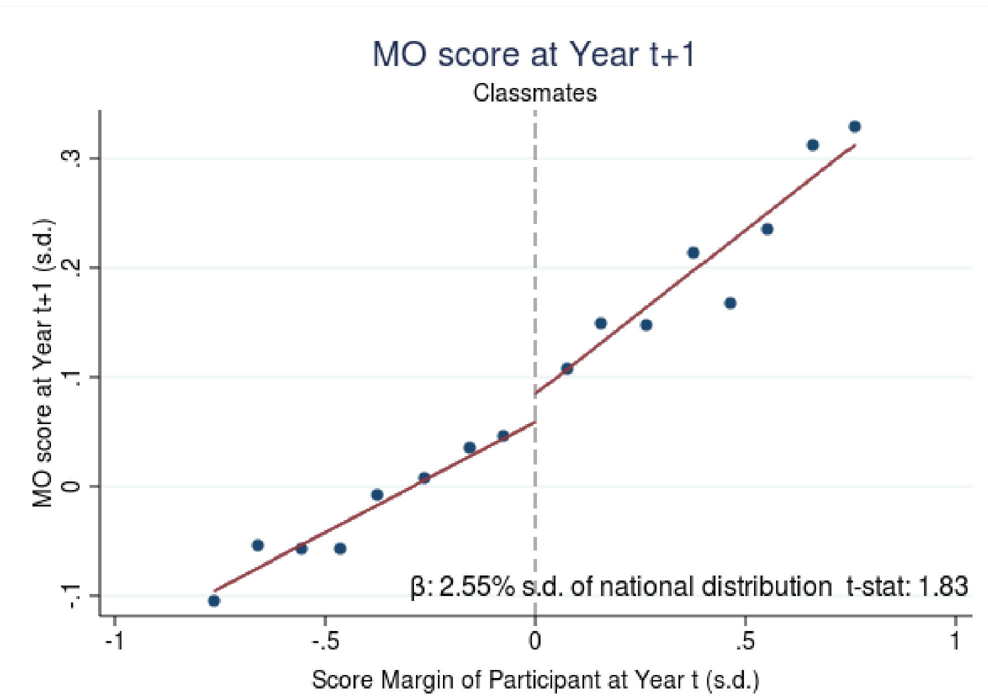
Figure A1: Number of Schools per Municipality in the RD sample



Notes: This figure presents the number of school per municipality in the RD sample and the geographic location in the map of Brazil of the corresponding municipality. In the map, the size of the circle represents the number of schools. It varies from the smallest circle, which represents 100 schools or less in the municipality, up to the largest circle which represents more than 500 schools in the municipality. The map refers to the first MO-cohort in the sample, 2009.

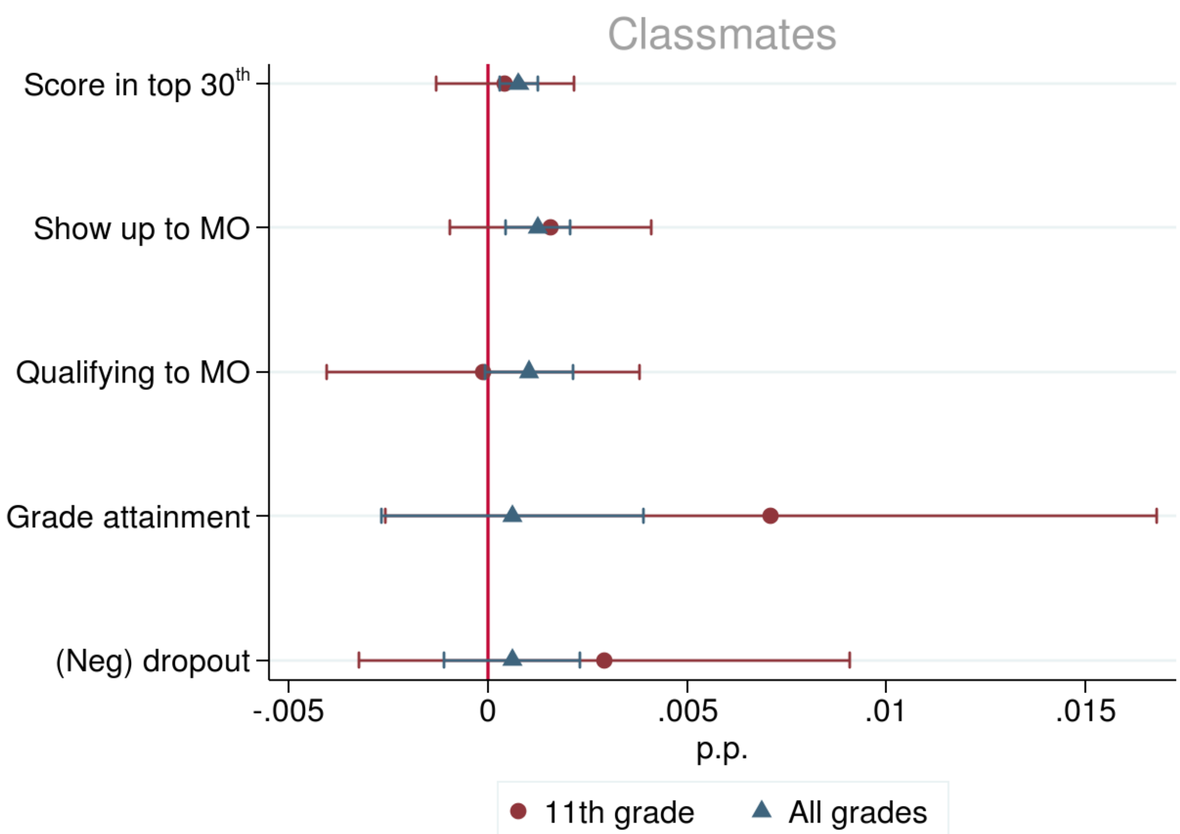
Figure A2: Math Olympiad Score at $t+1$ (Classmates)





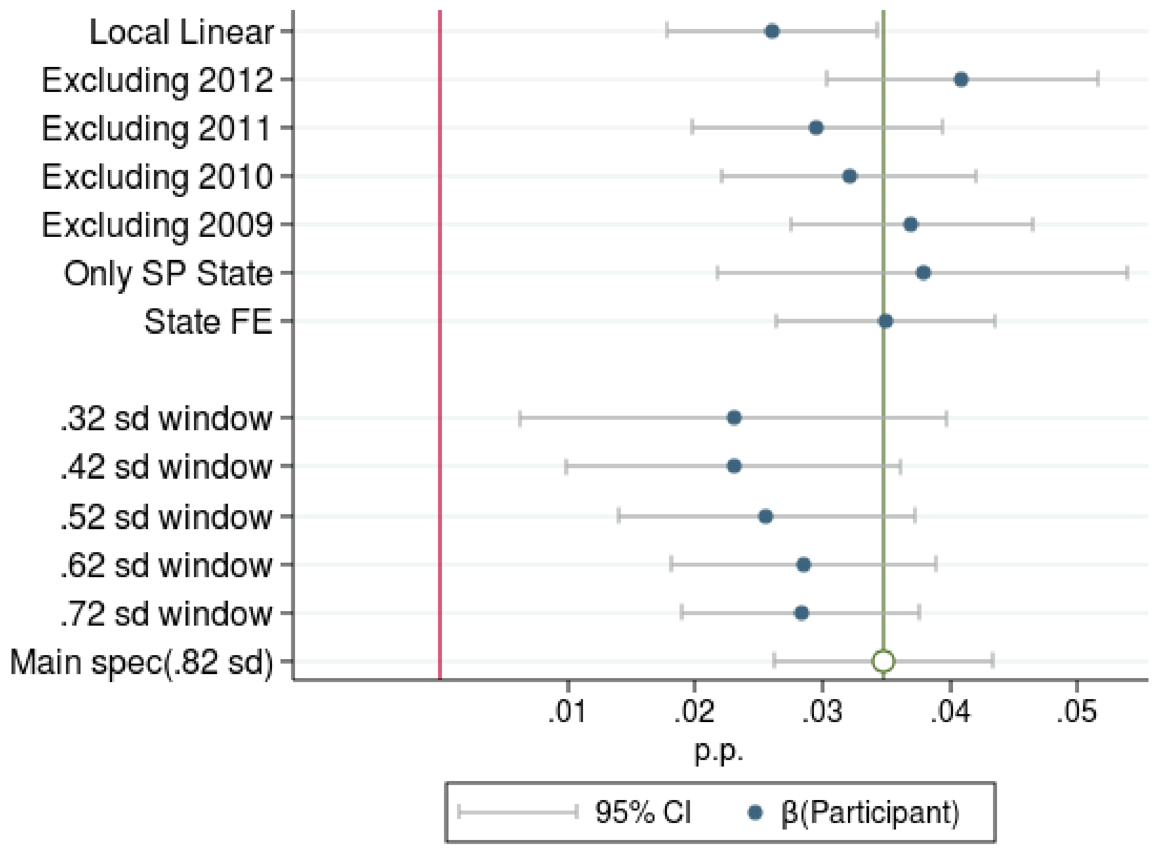
Notes: This figure is equivalent to Figure 7 Figure 6 but does not include controls for grade FE. The first figure plots Classmates' participation in the Math Olympiad at year $t+1$ as a function of score margin of the participant at year t (running variable). The second figure plots classmate's score in the Math Olympiad at year $t+1$ (in standard deviation units of national distribution) as a function of score margin of the participant at year t (running variable). See notes on Figure 4 for how observations are grouped in bins. The y-axis reports classmates' score in the Math Olympiad at year $t+1$ (in standard deviation units of national distribution). I report the corresponding regression result: The estimated β from equation 2, as well as the corresponding t-statistics.

Figure A3: Impact of Award assigned at Year t on Educational outcomes at $t+1$ for 11th grade vs. All grades (Classmates)



Notes: This figure reports the award impact on classmates' educational outcomes at $t+1$. Point estimate and 95% confidence interval is represented in red (circle) for the 11th grade sample, and in blue(triangle) for the sample including all grades (6th-11th grades)

Figure A4: Sensitivity to Alternative Specifications (Participant)



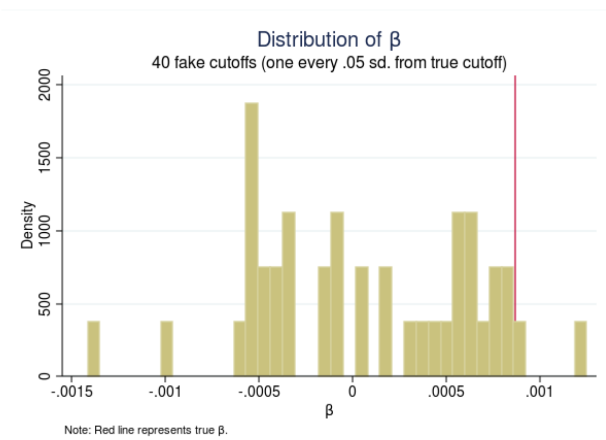
Notes: This figure report impact of award using alternative specifications. Outcome variable in all specification is equal to 1 if classmate's MO score at Year $t+1$ exceeds the 50th percentile of national score distribution (0 otherwise). Outcome variable is well defined (1 or 0) for the entire sample. Main spec (.82 s.d.) reports β estimated from equation **??** around a bandwidth of $h = .82$ with controls. The controls are: grade fixed effect, MO cohort-year fixed effect, indicator variables for each of the quartiles of national school quality distribution. Local linear implements a non-parametric local linear estimator. Excluding 2012, 2011, 2010 and 2009 estimate the main specification, excluding each of them a each of the MO cohort-years. Only SP state estimate the impact only for the state of Sao Paulo. State FE estimate the main specification with 27 dummies for the Brazilian states. The remaining estimate the main specification but varying the size of the bandwidth.

Figure A5: Permutation Exercise (Classmates)

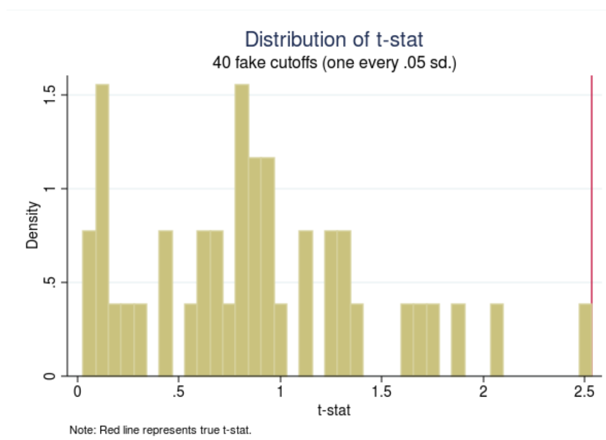
(a) Randomized vs. Asymptotic Inference

Panel A. Classmates	MO Score exceeding 50th percentile
Award	0.009
p-value asymptotic inference	0.018
p-value randomized inference (p-value rank)	0.024
p-value randomized inference (beta rank)	0.049

(b) Distribution of estimated β



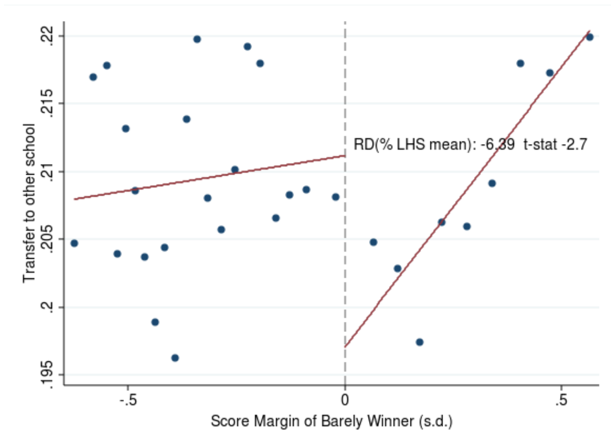
(c) Distribution of associated t-statistic



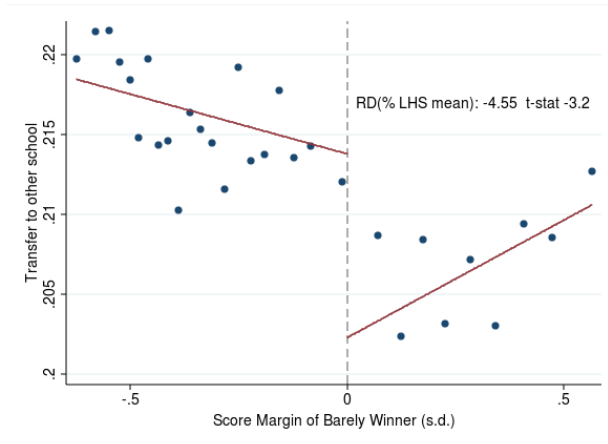
Notes: This figure reports the impact of the award and alternative randomized inference methods. Outcome variable is equal to 1 if classmate's MO score at Year $t+1$ exceeds the 50th percentile of national score distribution (0 otherwise). Outcome variable is well defined (1 or 0) for the entire sample. β and t-statistics are obtained by estimating the main specification for 40 fake cutoffs in the control region (one cutoff every .05 s.d.) using the corresponding optimal bandwidth

Figure A6: School Choice at $t + 1$

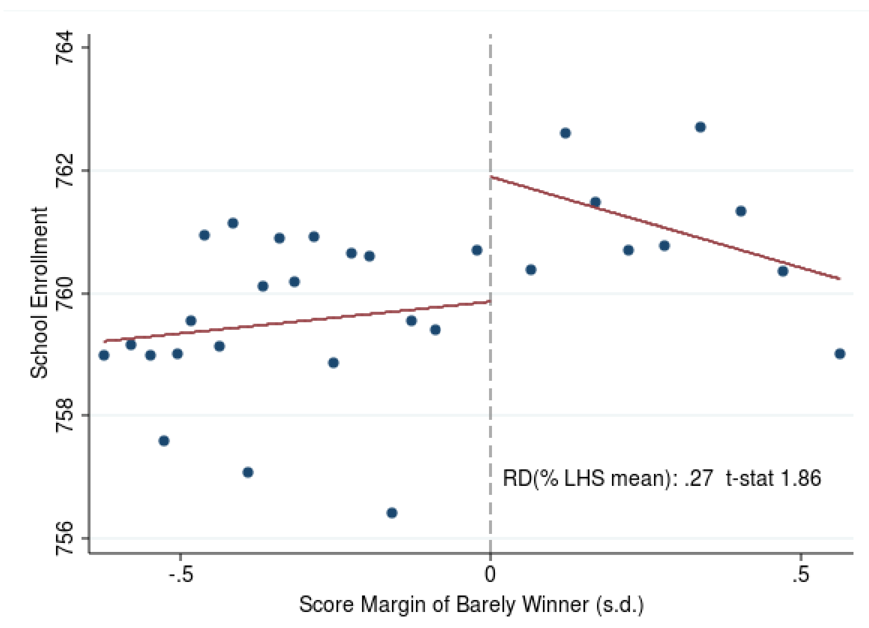
(a) Participant transfer to other school



(b) Classmates transfer to other school



(c) Total school enrollment



Notes: This figure plots school choice variables at $t + 1$ as a function of score margin of participant at year t (running variable). In panel A, the outcome represented in the y-axis is equal to one if the participant transferred to another school. In panel B, the outcome represented in the y-axis is equal to 1 if the classmates transferred to another school. In panel C, the outcome represented in the y-axis is equal to the number of students enrolled in the participant's school. In each figure I report the corresponding regression result: The estimated β from equation 1 divided by the control group mean of the corresponding outcome variable, as well as the corresponding t-statistics.

Table A1: Impact of Award assigned at Year t on MO score at Year t+1 (Participant and Classmates)

Participant	MO score at Year t+1	
	(1) lower bound	(2) upper bound
Award	0.0801***	0.8932***
	(0.0243)	(0.0272)
Students (obs.)	27,034	21,749
Classrooms (Clusters)	27,034	21,749
Dep. variable control s.d.	.89	.89
Classmates	MO score at Year t+1	
	(1) lower bound	(2) upper bound
Award	0.0293**	0.0341***
	(0.0124)	(0.0124)
Students (obs.)	127,331	127,187
Classrooms (Clusters)	77,191	77,133
Dep. variable control s.d.	.81	.81

Notes: The table displays award impact - upper bound and lower bound- on students' MO score at $t+1$ using a regression discontinuity design specified at equation 2. The upper bound is identical to the lower bound but makes a correction on the treatment sample (due to the selection bias generated by the award impact on participation in the MO). The correction based on Angrist et al. (2006) consists of including only the upper part of the distribution of scores - which assumes that the students that wouldn't have participated in the absence of the award score at the bottom. The regressions are all estimated on a sample within $h = .82$ s.d. above and below the award threshold. In addition to the $Award$ variable, the specifications include the following covariates (coefficients not reported): $Score_c$, $Award_c \times Score_c$. The models reported in columns 2, 3 and 4 contain controls. The controls are: grade fixed effect, MO cohort-year fixed effect, indicator variables for each of the quartiles of the national distribution of school quality distribution. Panel A report impact on *Participate in MO* which is equal to 1 if the student show up to the MO Exam at $t+1$. This outcomes is well defined, assuming values 1 or 0, (not missing) for the entire sample. Panel B reports award impact on MO score at $t+1$. Standard errors are clustered at the classroom level. Levels of significance: $*$ 10%, $**$ 5%, and $***$ 1%

Table A2: Impact of Award assigned at Year t on Math Olympiad Outcomes at Year t+1 and t+2

Panel A. Participants	Participated in MO exam		MO score above the median	
	(1)	(2)	(3)	(4)
	at t+1	at t+2	at t+1	at t+2
Award	0.0325***	0.0190***	0.0314***	0.0185***
	(0.0048)	(0.0043)	(0.0046)	(0.0042)
Students (obs.)	148,969	148,969	148,969	148,969
Classrooms (Clusters)	148,969	148,969	148,969	148,969
Dep. variable control mean	.13	.091	.11	.08
Panel B. Classmates	Participated in MO exam		MO score above the median	
	(1)	(2)	(3)	(4)
	at t+1	at t+2	at t+1	at t+2
Award	0.0011***	-0.0002	0.0010***	0.0002
	(0.0004)	(0.0004)	(0.0003)	(0.0003)
Students (obs.)	4,438,356	4,438,356	4,438,356	4,438,356
Classrooms (Clusters)	148,965	148,965	148,965	148,965
Dep. variable control mean	.024	.02	.012	.01
Bdw selection	.82	.82	.82	.82
Controls	Yes	Yes	Yes	Yes

Notes: Sample restricted to be a balanced sample: includes 6^{th}-10^{th} grades, 2009-2012 (excludes 11th grade). Restriction imposed for keeping the same sample in $t + 1$ and $t + 2$ specifications. Panel A reports the estimated β from equation 1 for the participant. Panel B, reports equation 2 for the classmates. In column 1 and 2, the outcome is equal to 1 if the student participated in the MO exam at different years (0 otherwise), column 1 assessed at $t + 1$, and column 2 assessed at $t + 2$. In column 3 and 4, the outcome is equal to 1 if the student's MO score exceeds the 50th percentile of national score distribution at different years (0 otherwise), column 1 assessed at $t + 1$, and column 2 assessed at $t + 2$. All outcome variables are well defined (1 or 0) for the entire sample.

Table A3: Impact of Award on Performance Outcomes for 11th grade (Participant)

	Outcomes (LHS)	Award (1) beta		(1) s.e.	(2) beta		(2) s.e.	(3) beta		(3) s.e.
Participant	Summary measure (s.d.)	0.0326		(0.0263)	0.0469	**	(0.0225)			
MO	Score in top 30th percentile	0.0597	***	(0.0158)	0.0576	***	(0.0132)	0.0576	***	(0.0132)
	Show up to MO exam	0.0492	***	(0.0166)	0.0507	***	(0.0139)	0.0537	***	(0.0135)
	Qualified to MO	0.0154		(0.0187)	0.0252		(0.0155)	0.0178		(0.0167)
SAT	Score in top 30th percentile	-0.0266		(0.0197)	-0.0101		(0.0159)	-0.0101		(0.0159)
	Score in top 60th percentile	-0.0296		(0.0193)	-0.0206		(0.0161)	-0.0206		(0.0161)
	Enroll	-0.0229		(0.0191)	-0.0103		(0.0159)	-0.0165		(0.0185)
Test Score	Std. Math+Language score (s.d.)	0.0972		(0.0803)	0.0735		(0.0684)	0.0598		(0.0728)
Progress in school	grade attainment	-0.0077		(0.0084)	-0.0046		(0.0070)	-0.0019		(0.0067)
	no dropout	-0.0024		(0.0066)	-0.0029		(0.0056)	-0.0021		(0.0055)
Bandwidth selection		h=.62			h=.82			(.62 < h < .89)		

Notes: Reports β from main specification specified at equation 1. Number of clusters for test score specification is 2717, for the remaining (MO, SAT and Progress in school) is 21346. Test score comes from SARESP only available for the State of Sao Paulo. Include controls: Grade FE, MO cohort FE and Quartile of school quality. Standard errors are clustered at the classroom level. Levels of significance: $*$ 10%, $**$ 5%, and $***$ 1%

Table A4: Impact of Award on characteristics of teachers who were assigned to the participant's classroom at $t + 1$

Panel A.	% tertiary education		% civil servant		Teachers' Age	
	(1)	(2)	(3)	(4)	(5)	(6)
Award	0.0064	0.0103*	-0.0224	-0.0041	-0.1835	-0.0641
	(0.0066)	(0.0057)	(0.0191)	(0.0141)	(0.3372)	(0.2901)
Classrooms (clusters)	4,927	4,927	4,854	4,854	4,927	4,927
Dep. Variable control mean	0.969	0.969	0.719	0.719	39.78	39.78
Std. Beta		1.1%		-0.6%		-0.2%
Panel B.	Number of teachers		Experience		% of new teachers	
	(1)	(2)	(3)	(4)	(5)	(6)
Award	0.0085	0.0649	0.0063	0.0327	0.0032	0.0030
	(0.1690)	(0.1525)	(0.0450)	(0.0362)	(0.0164)	(0.0159)
Classrooms (clusters)	4,927	4,927	4,927	4,927	4,927	4,927
Dep. Variable control mean	11.05	11.05	1.261	1.261	0.407	0.407
Std. Beta		0.6%		2.6%		0.7%
Lagged outcome	No	Yes	No	Yes	No	Yes

Notes: This table reports the award impact on the characteristics of the teachers that were assigned to the participant's classroom at $t + 1$ using a regression discontinuity design specified at equation 1. The regressions are all estimated on a sample within $h = .82$ s.d. above and below the award threshold. All the outcomes refer to the teachers that were assigned to the winners' classroom at $t + 1$. In panel A the outcomes are respectively, % of teachers with tertiary education, % of teachers who are civil servants, Average teachers' age. In panel B the outcomes are respectively, Number of teachers, Experience the average teacher has teaching that same school-grade pair. All columns includes controls. The controls are: grade fixed effect, MO cohort-year fixed effect, indicator variables for each of the quartiles of national school quality distribution. Odd columns also include the lagged outcome variable. Sample restricted to 11th graders and for 2011 year. Levels of significance: $*$ 10%, $**$ 5%, and $***$ 1%

Table A5: Impact of Award assigned at Year t on characteristics of participant's classmates at $t + 1$

Panel A.	% qualified to MO prior to award		% show up to MO prior to award	
	(1)	(2)	(3)	(4)
	1 year prior	previous 3 years	1 year prior	previous 3 years
Award	-0.0003	-0.0001	0.0001	0.0000
	(0.0006)	(0.0008)	(0.0005)	(0.0007)
Classrooms (Clusters)	165,665	165,665	165,665	165,665
Dep. variable control mean	.0796	.119	.0639	.0917
Bdw selection	.82	.82	.82	.82
Controls	Yes	Yes	Yes	Yes

Panel B.	% Score above the median	Number of students	Students' Age	
	(1)	(2)	(3)	(4)
	1 year prior to award		Average	standard deviations
Award	0.0001	0.1402	0.0002	-0.0016
	(0.0004)	(0.0952)	(0.0069)	(0.0055)
Classrooms (Clusters)	165,665	165,665	165,665	165,651
Dep. variable control mean	.0485	30	14	1
Bdw selection	.82	.82	.82	.82
Controls	Yes	Yes	Yes	Yes

Notes: This table reports the award impact on the characteristics of the students that were assigned to the participant's classroom at $t + 1$ (irrespective if they were classmates with the partcicipant at t). I use a regression discontinuity design specified at equation 1 estimated on a sample within $h = .82$ s.d. above and below the award threshold. All columns include controls. The controls are: grade fixed effect, MO cohort-year fixed effect, indicator variables for each of the quartiles of national school quality distribution. The regressions were estimated at the classroom level this is done to keep treatment and control units well defined - explained in detail in the text. Therefore, the outcomes represent the mean of the variables specified in the columns for all the students that were assigned to the winners' classroom at $t + 1$. In Panel A, column 1 and 2 the outcome are, % students qualified to the Math Olympiad 1 year prior to the award, and in the previous 3 years prior to the award. Column 3 and 4 the outcomes are respectively, % students show up to the Math Olympiad 1 year prior to the award, and in the previous 3 years prior to the award. In Panel B the outcomes are respectively, in column 1, % of students whose score exceeded the median 1 year prior to the award, in column 2, number of students in the participant's classroom at $t + 1$, in columns 3 and 4, average and standard deviations of the age of the students. Levels of significance: $*$ 10%, $**$ 5%, and $***$ 1%

Table A6: Impact of Award assigned at Year t on Performance in MO at $t+1$ by Students' gender or race (Participant and Classmates)

Panel A. Participant	MO score above the median at t+1			
	(1)	(2)	(3)	(4)
Award	0.0422***	0.0402***	0.0422***	0.0466***
	(0.0049)	(0.0060)	(0.0061)	(0.0071)
Award x Female	-0.0165***		-0.0169*	
	(0.0043)		(0.0088)	
Award x Non-white		0.0025		-0.0150
		(0.0057)		(0.0117)
Students (obs.)	170,335	102,106	170,335	102,106
Classrooms (Clusters)	170,335	102,106	170,335	102,106
Dep. variable control mean	.1072	.1085	.1072	.1085
Linear combination:β	.02568	.0427	.02528	.03159
Linear combination: s.e.	.004919	.006654	.006376	.009245
Panel B. Classmates	MO score above the median at t+1			
	(1)	(2)	(3)	(4)
Award	0.0016***	0.0018***	0.0012***	0.0014**
	(0.0003)	(0.0005)	(0.0004)	(0.0006)
Award x Female	-0.0009***		-0.0000	
	(0.0003)		(0.0006)	
Award x Non-white		-0.0010***		-0.0001
		(0.0003)		(0.0007)
Students (obs.)	5,114,922	3,070,823	5,114,922	3,070,823
Classrooms (Clusters)	170,331	163,305	170,331	163,305
Dep. variable control mean	.01223	.01307	.01223	.01307
Linear combination:β	.000749	.0008011	.001156	.001308
Linear combination: s.e.	.000342	.0004346	.0004052	.000513
Bdw selection	.82	.82	.82	.82
Controls	Yes	Yes	Yes	Yes
Full interaction	No	No	Yes	Yes

Notes: The table displays heterogeneous effects of the award impact on on students' performance in the Math Olympiad at $t+1$ by the student characteristics (gender or race). Panel A report results for the participant, and in Panel B, for the classmates. The specification is equivalent to equation 2 and includes interactions with classmates' gender and race explained as follows. The specification in the first two columns include the additional variable: $Female$. The specification in the last two includes: $Female$ as well as its interaction with $Score_c$, $Award_c \times Score_c$. All are estimated on a sample within $h = .82$ s.d. above and below the award threshold. All columns include controls. The controls are: grade fixed effect, MO cohort-year fixed effect, indicator variables for each of the quartiles of national school quality distribution. Outcome variable is the same in all specifications and it is a binary variable equal to one if the student score exceeded 50th percentile of the MO national distribution (score above the median). In the first and third column, the interaction is equal to one if the classmate is female. In the second and forth columns, the interaction is equal to one if the classmates is non-white. Standard errors are clustered at the classroom level. Levels of significance: $*$ 10%, $**$ 5%, and $***$ 1%

Table A7: Impact of Award assigned at Year t on Performance in MO at $t+1$ by classmates' social proximity to the participant (Classmates)

Classmates	MO score above the median at t+1	
	(1)	(2)
Award	0.0009*	0.0017**
	(0.0005)	(0.0008)
Award x Same gender as participant	0.0004	
	(0.0008)	
Award x Same race as participant		-0.0005
		(0.0012)
Students (obs.)	2,667,010	1,164,824
Classrooms (Clusters)	170,220	100,992
Dep. variable control mean	.0115	.01079
Bdw selection	.82	.82
Linear combination:β	.001385	.001165
Linear combination: s.e.	.000648	.0008441
Controls	Yes	Yes
Full interaction	Yes	Yes
Sample Restriction: Classmate is from minority group	Yes	Yes

Notes: This table reports results from same specification as Table 15 columns 4 and 5 with a additional constraint: restricts the sample for classmates that are from the minority group - Sample for the results reported in column 1 includes only female classmates; Sample for the results reported in column 1 includes only non-white classmates. The table displays heterogeneous effects of the award impact on on students' performance in the Math Olympiad at $t+1$ by classmates' social proximity the participant (assessed prior to the award). Panel A report results for the participant, and in Panel B, for the classmates. The specification is equivalent to equation 2 and includes interactions with classmates' gender and race explained as follows. The specification includes additional variables: $Female$ as well as its interaction with $Score_c$, $Award_c \times Score_c$. All are estimated on a sample within $h = .82$ s.d. above and below the award threshold. All columns include controls. The controls are: grade fixed effect, MO cohort-year fixed effect, indicator variables for each of the quartiles of national school quality distribution. Outcome variable is the same in all specifications and it is a binary variable equal to one if the student score exceeded 50th percentile of the MO national distribution (score above the median). In columns 1 and 4, the interaction is equal to one if the classmate and the participant is of the same gender. In columns 2 and 5, the interaction is equal to one if the classmate and the participant is of the same race. Standard errors are clustered at the classroom level. Levels of significance: $*$ 10%, $**$ 5%, and $***$ 1%

Table A8: Impact of Award assigned at Year t on School Choice at $t+1$

	Transfer to other school		School Enrollment	
	(1)	(2)	(3)	(4)
	Participant	Classmates		+ Lagged Enrollment
Award	-0.0130***	-0.0096***	5.0388	2.0111*
	(0.0048)	(0.0030)	(6.1655)	(1.0814)
Controls	Yes	Yes	Yes	Yes
Students (Obs)	114,802	3,306,056	117,688	117,688
Classrooms (clusters)	114,802	117,872	117,688	117,688
Dep. Variable control mean	.2	.21	756	756
Dep. Variable control SD	.4	.41	460	460

Notes: This table reports the award impact on school choice variables at $t+1$. I use a regression discontinuity design specified at equation 1 estimated on a sample within $h = .82$ s.d. above and below the award threshold. All columns include controls. The controls are: grade fixed effect, MO cohort-year fixed effect, indicator variables for each of the quartiles of national school quality distribution. The outcome in columns 1 and 2 is whether the student transferred to another school at $t+1$, column 1 refers to the participant, column 2 refers to the classmates. In column 3 and 4 the outcome variable is the total number of enrolled students. The difference between column 3 and 4 is that, column 4 includes an extra control: the total number of students enrolled in the school one year prior to the award. Standard errors are clustered at the classroom level for classmates-level regression. Levels of significance: $*$ 10%, $**$ 5%, and $***$ 1%

Table A9: Impact of Award assigned at Year t on Transfers to private schools at $t+1$

	Transfer to private school	
	(1)	(2)
	Participant	Classmates
Award	-0.0032	-0.0006
	(0.0024)	(0.0005)
Controls	Yes	Yes
Students (obs)	114,554	3,298,438
Classrooms (clusters)	114,554	117,619
Dep. Variable control mean	.024	.013
Dep. Variable control SD	.15	.12

Notes: This table reports the award impact on school choice variables at $t+1$. I use a regression discontinuity design specified at equation 1 estimated on a sample within $h = .82$ s.d. above and below the award threshold. All columns include controls. The controls are: grade fixed effect, MO cohort-year fixed effect, indicator variables for each of the quartiles of national school quality distribution. The outcome in columns 1 and 2 is whether the student transferred to a private school at $t+1$, column 1 refers to the participant, and column 2 refers to the classmate. In column 3 and 4 the outcome variable is the total number of enrolled students. The difference between column 3 and 4 is that, column 4 includes an extra control: the total number of students enrolled in the school one year prior to the award. Standard errors are clustered at the classroom level for classmates-level regression. Levels of significance: $*$ 10%, $**$ 5%, and $***$ 1%

Table A10: Impact of Award assigned at Year t on MO performance at Year $t+1$ by Classmates' MO performance at Year t

Classmates	MO score above the median at Year t+1	
	(1)	(2)
Award	0.0011***	0.0011***
	(0.0003)	(0.0003)
Award x Parcitipated in MO Exam at t	0.0030	
	(0.0033)	
Award x MO score above median at t		0.0050
		(0.0052)
Students (obs.)	5,114,922	5,114,922
Classrooms (Clusters)	170,331	170,331
Dep. variable control mean	.01223	.01223
Bdw selection	.82	.82
Linear combination:β	.004065	.006105
Linear combination: s.e.	.003307	.005201
Controls	Yes	Yes

Notes: This table reports the award impact on the performance in the Math Olympiad at $t+1$. The specification is equivalent to equation 2 and includes full set of interactions with measures of MO participation at t explained as follows. It is estimated on a sample within $h = .82$ s.d. above and below the award threshold. All columns include controls. The controls are: grade fixed effect, MO cohort-year fixed effect, indicator variables for each of the quartiles of national school quality distribution. The outcome is equal to 1 if the MO score was above the median. In column 1, the interaction variable is equal to 1 if the student participated in the MO Exam at t. In column 2, the interaction variable is equal to 1 if the student's MO score exceeded the 50th percentile. "Linear combination:β" reports the linear combination of the interaction term and the Award variable. "S.E." reports the corresponding standard errors. Standard errors are clustered at the classroom level. Levels of significance: $*$ 10%, $**$ 5%, and $***$ 1%

A.2 Data sources and mapping students across data sets

Procedure to identify individuals across data sources

A challenge in using several data sources is that often there is not a unique code for the individual to be tracked across data sets. I used in total seven data sets. Five out of the seven data sets use the same student identifier which is the student ID in the Census of Primary and Secondary Education. The remaining two data sets use a different student identifier. I therefore follow a matching procedure to recover the students ID of the census[46]. The two data sets are: The administrative data of the Math Olympiad and administrative data from the Secretary of Education of the State of Sao Paulo. The procedure to match both data sets is almost identical. I will explain in detail the matching for the Math Olympiad data as this has implications for the definition of the sample. In order to match the Math Olympiad students with the Census of Primary and Secondary Education, I use common characteristics in both data sets that *refer and are reported prior to the treatment*. Precisely, I use the following characteristics: school identifier, students' grade, date of birth and gender that are reported in year t. 70% of participants are uniquely matched using only these criteria. Since common variables used are reported prior to the treatment there is no reason to believe that the award assignment explains probability of being matched. To be on the safe side, I test for whether this holds empirically. I confirm that the award assignment does not explain the probability of successful unique match.[47]. The Census of Primary and Secondary Education has information of classroom assignment for all schools in the country. Therefore, once I have the student ID of the participants of the Math Olympiad, I recover the identity of the participants' classmates at time t. Each participant has around 30 classmates, this is the sample of classmates that I follow throughout regardless if the student is no longer his classmate in $t + 1$. Lastly, I can merge with the remaining five data sets that uses the census student ID. [48]

[46] Every student enrolled in any school in Brazil *must* have a student ID in this census.

[47] The specification was $1 Students i is uniquely matched = \beta \times Award_i + \varepsilon_i$ estimated around the RD window. $\hat{\beta}$= -.18% of LHS mean and $p - value = 56\%$

[48] The procedure for matching the other data set, data from the secretary of Education from the state of Sao Paulo, has only one difference: the variables used for the matching are reported in $t + 1$ rather than t. This data set is used only for the test score outcome. This implies that students that were enrolled in schools managed by the State of Sao Paulo and transferred to another school not managed by the State of Sao Paulo will not have test score data. I do not think this is a point of concern because of two reasons: first, while I cannot recover the test score of the student who moved, using the census data I can assess what happen to the student who moved regarding his performance in the other outcome variables. Second this only affects this outcome variable

A.3 Conceptual Framework

To guide the empirical analysis I discuss the relationship between students' educational achievements and the award. In particular emphasizing the mechanisms that I discuss empirically: Encouragement vs. Resource channel; and individual-specific updating or general updating. Since the empirical variation used is at the classroom level, I start with the classroom unit and decompose into what one should expect for the recognized student and extend the discussion to the classmates. I refer to the classroom as a stable unit which consists on the Participant, Classmates and Teachers at time the award is assigned (Year t).[49]

$$Achievement^{j}_{t+1} = effort^{j}_{t+1} \times r_{t+1} \tag{4}$$

Where $Achievement^{j}_{t+1}$ is a vector of the the students' educational achievement in classroom j. $Effort^{j}$ is the level of effort of teachers and students in classroom j. r_{t+1} is the contemporaneous returns to effort, which includes inputs relevant for the students' academic achievement measured at $t+1$. This includes individual-specific components —the individual preference, his ability and his characteristics —a general component which includes the inputs that are provided to the individual—quality of the teacher, the students' ability, quality of the school, textbooks and other inputs in education. I refer to the overall contemporaneous returns to effort as: resources. The individual chooses effort to maximize expected returns from effort accounting for the cost of effort (removing time subscripts for simplicity):

$$Effort^{j*}_{i} = \arg\max E_{\lambda_R}[effort^{j}_{i} \times R + g(effort^{j}_{-i})] - c(effort^{j}_{i}) \tag{5}$$

Where $effort^{j*}_{i}$ is the chosen level of effort of a individual i. The individual makes effort decisions having incomplete information about the true returns to effort (R), which includes the contemporaneous returns to effort (r_{t+1}) as well as future returns (r_{t+n}) such as labor market returns or admission to college. The expected payoff also depends on the effort decisions of others ($effort^{j}_{-i}$), and I assume for simplicity no complementarity between effort of different individu-

[49] In practice, students and teachers can transfer schools, classrooms or even fail a grade. I follow the students' performance no matter if they transfer. Therefore, r_{t+1} is a theoretical concept that refers to the resources (next paragraph defines resources) available to the students' at $t+1$ whatever classroom he is assigned to. I test whether the award impacts the quality of such resources systematically.

als. Therefore, Effort choice depends on the cost of exerting effort $c(effort_i^j$ and on the perceived returns to effort (λ_R). $c(effort_i^j$ is a concave function of effort and λ_R is a reduced form for the subjective elements in the decision process of the individual which captures the beliefs about the returns to effort R as well as preference and interests over achievement.

The award can impact $Achievement$ through a Resource channel ($r_{t+1} = f(Award)$) or through a Encouragement channel ($effort = f(Award|r_{t+1})$). Regarding the Resource channel, the award could affect resources that are given to the classroom r^j or resources that are individually-targeted r_i. Regarding the Encouragement channel the award can affect students' or teacher's behavior by affecting future returns to effort ($r_{t+n} = f(Award)$) or subjective perceived returns to effort ($\lambda_R = f(Award|r_{t+1}, r_{t+n})$). The main difference between Participant's and Classmates' Efforts and achievements is regarding the importance of these different mechanisms. While all these mechanism are relevant for the participant, for the classmates the award should not impact resources that are targeted to the individual r_i, and should not impact future returns to effort ($r_{t+n} = f(Award)$) as it is unlikely the award serves classmates to access future opportunities in the same way it serves the winner. I assume that the teachers' returns to effort R is equivalent as the returns for the participant. The idea is that teachers value having a successful student and exert higher effort when the returns the student can obtain are higher. Teachers' effort decision will look exactly like the participant and therefore any prediction for participant's effort, would also be valid for teacher's effort.

The first set of empirical tests ask whether the award has a causal impact on Participant's achievement ($Achievement_{t+1}$). This has been examined in other contexts using different forms of recognition and the majority of the studies finds positive consequences on subsequent students' performance.[50] I find positive consequences on the winner's subsequent performance. As I emphasized, this can be a result of Resource channel (resources that are assigned to the classroom r^j or resources that are individually-targeted r_i) or due to a encouragement channel (due to greater future returns to effort ($r_{t+n} = f(Award)$) or just an update on the subjective perceived returns to effort ($\lambda_R = f(Award|r_{t+1}, r_{t+n})$).

[50]To name a few: Thistlethwaite and Campbell (1960) examines the impact of an scholarship program on the recognized student subsequent performance and find no impact. Ebenstein, Lavy, and Roth (2016) and Dee et al. (2016) study the impact of a greater score on a high-stakes exam on the students' subsequent educational outcomes. Jacob and Lefgren (2004) and Diamond and Persson (2016) study the impact of a failing grade on subsequent educational and labor market outcomes.

The second set of empirical tests ask whether the award has a causal impact on Classmate's achievement ($Achievement_{t+1}$). Several debates such as role models and aspiration failure rely on the idea that the success of a person spills over to others - either positively or negatively. The award can positively affect the perceived returns to effort as the student learn about the goals that are within reach, as well as due to competitive motives, the student may have a greater desire to succeed. However, depending on the distance the student perceive himself from the winner, the success of a peer could also discourage classmates' behavior.[51] Therefore, understanding the magnitude of this impact, especially for students at different degrees of proximity to the winner is important. The magnitude of the spillover to classmates are also important for the cost-benefit analysis of these programs. I therefore provide several benchmarks to this magnitude. An additional reason to study the impact on classmates is due to the difference in the mechanisms. The impact on classmates is more likely to be driven by an Encouragement channel (as the award shouldn't affect the resources that are individually-targeted r_i), and moreover, a encouragement that is more likely to be a result of changes in the subjective perceived returns to effort $\lambda_R = f(Award|r_{t+1}, r_{t+n})$ than the results on the recognized student (as the award shouldn't affect r_{t+n} for the classmates). It therefore goes one step further in testing for whether the subjective perceptions of students about the returns to effort are a important determinant of student's achievement. In practice, I provide several tests at the end of this section which all show that the award did not impact resources to the classroom. This suggest that the spillovers is a result of an encouragement channel - award impact effort in the classroom.

What mediates the spillovers? There could be different mechanisms resulting in behavioral changes in the classroom - Encouragement channel ($effort = f(Award|r)$). I will group them in order to connect with my empirical tests[52]. Any change in behavior must be a result on changes in the perceived returns to effort which can refer to a individual-specific component —the individual preference, his ability and his characteristics; or refer to a general component which captures the inputs that are provided to the individual.

The award can affect teacher's and students' effort by providing *individual-specific information*

[51] The teacher could also change behavior in a way that is detrimental to low-performing students. Since this would be conceptually similar to a reallocation of resource, I discuss this possibility together with the other resource explanations (r_{t+1}).

[52] I use a similar grouping as Sequeira et al. (2016) which facilitates comparing with their findings

affecting perceived returns to effort in the vicinity of the winner. This can take several forms: beliefs updating about the ability of a student like the winner and what he can achieve which would be consistent with a role model effect; update on interests of students as the success of the peer may effect his willingness to succeed which would be consistent with a aspiration failure effect. The direction of the effect is theoretically ambiguous, but in general should be stronger the closest the classmate is to the winner along different dimensions. I investigate three of such dimensions - proximity in terms of ability, physical proximity and social proximity. I discuss the predictions when I describe the results. I find that proximity in terms of ability and physical proximity to the winner are associated with greater positive spillovers on classmates performance, and no differential impact for social proximity.

The award can affect effort by providing *general information about education*: how much society values math skills, information about the Math Olympiad program, and other information that is not specific to the individual who won the award. Consistent with Sequeira et al. (2016), I find evidence supportive of this mechanism. However, I find that grade-mates (excluding classmates) are aware of the award, but do not experience a performance improvement. based on this evidence, I conclude that *general information about education* mechanism doesn't explain the students' increase in achievement. This suggests that the classmates' performance are driven by updates (preference or on beliefs) regarding the individual-specific component of the returns to effort.

My interpretation of the results is that the award encourages students' and potentially teachers' effort by affecting the perceived returns to effort that refers to students' in the winners' vicinity. Moreover, taken together the classmates' performance result are at least in part explained by classmates' change in preference or beliefs. Precisely, I present two empirical exercises that speaks to this. First, the classmates experience a performance improvement even when they are assigned to a different classroom from the winner at $t + 1$. This suggests that at least in part this is driven by student's change in behavior rather than teachers' behavior. Second, the impact on classmates performance lasts for only one year, while the impact on the participant's performance persists. This is suggestive of either a change in preference, or also is consistent with a more complex beliefs' updating story: as time passes the information is no-longer salient and therefore, students don't exert effort; alternatively it is also consistent with a story where students update their beliefs, which result in greater effort, they then don't make it and stop trying.

Resource Channel (r_{t+1}) I denominate *resources* to include all the inputs that can directly affect the student's achievements at $t+1$. From now on, I remove time subscripts for simplicity. There are two types of such inputs: the ones that are provided to the classroom r^j and the ones that are provided individually for a student i r_i. r^j includes quality of the teacher, the students' ability, school infrastructure. While r_i includes parental inputs, additional extra-classroom training and other learning opportunities that can be provided directly to a student. The award could affect r^j. The two most important inputs in the classroom are the quality of the peers and the quality of the teachers. I provide empirical evidence that the award does not impact teacher sorting or students sorting to the winner's classroom at $t+1$. A slightly different story would be that the teachers are reallocating effort from the bottom to the top of the classroom - for example, changing the level of instruction. However, I find no evidence that there are negative consequences for the bottom: No negative effect on dropout, grade attainment and standardized test score, as well as no negative effect on standardized test score using nonparametric quantile regression models - All estimates of the impact of the award in the parametric and nonparametrict quantile models are positive but statistically not significant. The award could instead impact $r_i = f(Award)$. For example, the award can affect the winner's chances to enter into a private school, or it can just alter the investments teachers and parents provide him outside of the classroom. Testing for such stories is challenging. I provide a direct test for whether there is an increase in r_i for the winner, as well as complement the argument by emphasizing the scope of the impact on classmates. In order for this mechanism $r_i = f(Award)$ to rationalize the results on classmates it must be that this winner-individually targeted inputs are somehow also affecting the classmates. The results on classmates is suggestive that this mechanism is less likely to explain all the results. Moreover, the patterns of the results on classmates also suggests that the rational behind the impact on the Participant is different from the impact on classmates. First, classmates who are no longer in the winner's classroom at $t+1$ also experience a performance improvement. Second, I present weak evidence that the award impact on participant's performance is concentrated on Math subjects, while classmates' improvement are found in math-related and non-math related subjects.