Cultural Integration in the Classroom: The Role of Students, Parents and Teachers*

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Abstract

The integration of ethnic minority students in the classroom could change the behavior of students, parents and teachers of ethnic majority. Using random assignment of children to classrooms in Taiwanese middle schools, we show that exposure to Indigenous but not Hakka minorities lowers test scores of the ethnic majority students. These negative effects are primarily due to endogenous responses of parents and teachers rather than those of students or other characteristics correlated with indigeneity. We conclude that parental and teacher behavioral adjustments rather than direct exposure to minority children are plausible explanations behind the observed negative effects of classroom exposure to Indigenous students.

JEL: I23, I26, D13
Keywords: ethnic minorities, Indigenous Peoples, peer effects, parental investments, school production function

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1 Introduction

A minority is defined as any group of people who, because of their physical or cultural characteristics, are singled out from others in the society in which they live for differential and unequal treatment, and who therefore regard themselves as objects of collective discrimination (Wirth, 1945). This definition connotes historical disadvantages, direct discrimination, and general lack of power of certain groups of people in a given society in which they live. Notably being a minority does not have to be limited to race or ethnicity but could likewise include cultural disadvantage. There is extensive research on how minorities shape societies, as well as how societies might compensate minorities for their historical disadvantage and discrimination (Kymlicka, 1995, 2017, Vasta, 2007). In many cases, the proposed solutions for the latter question revolve around increasing human capital of minority children so that they can successfully overcome the disadvantage that their parents faced (Coleman, 1968, Heckman, 2000, Alba, Sloan and Sperling, 2011).

A pre-requisite for increasing human capital of minority children is offering them access to high quality schools, which are often attended by majority populations. This creates a tension between minority and majority parents as well as teachers, often leading to pushback and increased segregation (e.g., Card and Giuliano (2013), Geay, McNally and Telhaj (2013), Cascio and Lewis (2012), Ohinata and Van Ours (2013)). Yet, while we have limited causal evidence on the effects of exposing majority children to minority peers in the classroom, we know even less about how such exposure could affect parents and teachers. Exposure to minority peers could lead to positive spillovers due to externalities from increased diversity or more resources dedicated to teaching; there could also be no effects if minority status is not an important input in the human capital production function. Finally, one could also find negative effects, either due to other unfavorable characteristics correlated with minority status or due to negative behavioral changes of students, their parents, or their teachers. For example, minority students tend to come from lower income families, and income itself can have causal effects on human capital of other students in the classroom aside from minority status.

In this paper, we study the effects of exposure to ethnic minorities in the classroom on the academic performance of majority students as well as changes in behaviors of their parents and teachers. We do this in the context of Taiwan and two separate and distinct minority groups: Indigenous Peoples and Hakka. We find that in classrooms with a one standard deviation higher share of Indigenous peers, ethnic majority students test scores are on average 1.9% of a SD lower. We do not find similar effect for Hakka minority and based on 95% confidence intervals we can rule out negative effects as small as 0.9% of a SD.

We then investigate four potential mechanisms beyond these uncovered negative externalities generated by Indigenous students. We first attempt to rule out that the negative effects are driven by other characteristics correlated with indigeneity, where we consider differential ability and

language skills of Indigenous students, socioeconomic status of their households, and finally investments of Indigenous parents directed towards their children. We find that only about 1/3 of the negative peer effects can be explained by factors correlated with indigeneity while the primary confounder appears to be differential academic ability of Indigenous students. Second, we consider changes in behaviors of majority students, their parents as well as teachers assigned to these classrooms. We do not find any statistically significant changes in behaviors of ethnic majority students, and, if anything, the positive coefficients suggest productive improvements. On the other hand, we document that both ethnic majority parents and teachers in classrooms with Indigenous peers change their behaviors in a way that is correlated with negative test scores of ethnic majority children. This channel accounts for almost 2/3 of the estimated negative peer effect. Overall, our findings suggest that although exposure to Indigenous students has a negative effect on the test scores of majority students, those classroom externalities are largely generated by adjustments made by teachers and majority parents rather than directly by indigeneity of the minority students.

We study the effects of exposure to minority peers in the context of Taiwan which has multiple institutional features that allow us to credibly answer our research questions. First, Taiwan has two important minority groups officially recognized by the government – Hakka and Indigenous Peoples. This allows us to abstract from subjectively classifying children into minority and majority groups. Second, the local education system requires – based on the arguments of equity and non-discrimination – random assignment of students to classrooms within junior high schools. This is a feature almost non-existent in compulsory school settings and it allows us to estimate linear-in-means models that are not confounded by issues of selection and reflection which have plagued previous research (Angrist, 2014). Finally, the Taiwan Education Panel Survey used in this paper allows us to track a large cohort of students through junior high school and provides rich information not only on classroom composition but also on children's parents and their teachers. In turn, this allows us to document a new set of mechanisms, beyond student characteristics, which could generate the observed peer effects.

Our primary contribution is to the literature on peer effects and their mechanisms. To the best of our knowledge this is the first paper documenting minority peer effects in compulsory education where children are randomly allocated to their peers and teachers[1]. Prior studies, primarily using US data due to their ethnic-racial history, were mostly forced to utilize cohort-by-school variation due to lack of randomization (Hoxby, 2000, Diette and Oyelere Uwaifo, 2014, Figlio and Özek, 2019, Angrist and Lang, 2004, Geay, McNally and Telhaj, 2013). This source of

1. There are prior studies exploiting random assignment to schools in Korean middle schools, and random assignment to classrooms within schools in Chinese middle schools. None of those studies, however, have estimated minority peer effects; rather they have focused on estimating the impact of studying with higher-achieving peers, female peers, children of college-educated parents or teacher-student match effects (see e.g. Kang et al., 2007, Fang and Wan, 2020, Chung, 2020, Lim and Meer, 2017, 2020, Feng and Li, 2016)

exogenous variation, however, is not without issues as Vigdor and Nechyba (2007) show that within-school comparisons are not always valid due to e.g. changes in local school markets affecting peer-composition over time. Second, we study two different minority groups in the same paper and document that they can generate very different effects. This is important for understanding the generalizability of peer effects estimates –in particular to reconcile the long stream of inconsistent findings of this literature– and to inform policy-makers and education decision-makers on how to direct limited resources in a targeted way. Most prior work focused on a single group such as immigrants (e.g. Figlio and Özek, 2019, Figlio et al., 2021, Diette and Oyelere Uwaifo, 2014, 2017) or refugees (e.g. Alan et al., 2021, Imberman, Kugler and Sacerdote, 2012, Green and Iversen, 2022, Morales, 2022). One notable exception is Hoxby (2000), who distinguishes between multiple racial groups using data from Texas, and finds negative and statistically significant estimates only for Black peers. Third, this is one of the first papers investigating the black box of mechanisms behind the observed peer effects and the first one to our best knowledge to do this in the context of minority peers. In that, we propose that agents other than students themselves –namely parents and teachers– can contribute to the observed data patterns. This means that researchers should view peer effects findings more broadly through a multi-factor production function which goes beyond the direct interactions between students. Finally, we provide some of the first evidence on educating Indigenous children, a group of people that has largely been omitted from research due to data limitations. Studying how Indigenous children can be integrated in ethnic majority schools is important givent that Indigenous Peoples face deep and perpetuating disadvantage –they represent about 5% of the global population but as much as 15% of the world's extremely poor (Hall and Patrinos, 2014). Furthermore, they are not evenly distributed within countries; thus, there are regions where effects such as those we document in this paper might be pervasive, leading to starker integration difficulties between minority and majority stakeholders (e.g., in the US in Alaska 15% of inhabitants are Indigenous, while in Taiwan in Hualien County 30% of the population is Indigenous).

Although our focus is on compulsory education and younger children, this paper is also naturally linked to the broader literature on peer effects in education. Considering university-level coursework there are several papers which use random assignment to peers to identify the effects of interest (e.g., Carrell, Fullerton and West (2009), Carrell, Sacerdote and West (2013) in the US, Feld and Zoelitz (2017) in the Netherlands, Garlick (2018) in South Africa, and Brunello, De Paola and Scoppa (2010) in Italy). However, even in this literature, to the best of our knowledge, only Chevalier, Isphording and Lisauskaite (2020) specifically focus on minority status of peers – in their case non-native speakers at a British university – and on the issue of language barriers in the classroom which we also consider in our analysis. Unlike us, they do not find any negative spillovers from non-native to native speakers in terms of their grades.

More broadly, there is a long-standing discussion on the effects of school racial and ethnic diversity on the student achievement, which has produced mixed empirical evidence. In the United States, Hoxby (2000) provided evidence on the impact of racial diversity in high school

on student performance and found that exposure to Black peers is particularly detrimental to the achievement of other students in these school. Card and Rothstein (2007) find a strong associations between racial segregation in neighborhoods and schools and the Black-White gap in SAT scores. Angrist and Lang (2004) analyze spillovers generated by school integration policies, and find short-lived, small to null effects on test scores. Hanushek, Kain and Rivkin (2009) estimate the effect on student achievement of studying in racially diverse schools keeping school quality constant, and find large negative effects for Blacks, especially higher ability Black students, and small negative effects for White and other non-White minorities. A related but separate strand of literature focusing on ethno-linguistic diversity in school has also yielded mixed findings (e.g. Cho, 2012, Diette and Oyelere Uwaifo, 2014, 2017, Geay, McNally and Telhaj, 2013, Tonello, 2016, Ohinata and Van Ours, 2013, 2016, Friesen and Krauth, 2011, Gould, Lavy and Daniele Paserman, 2009, Jensen and Rasmussen, 2011, Ahn and Jepsen, 2015, Hunt, 2017). Both strands of literature share two common limitations: lack of random assignment of peers and their inability to delve into the mechanisms underlying the findings. On the other hand, three recent small-scale experimental studies focused on the effect of exposure to refugees on pupils' attitudes, prejudice and friendship formation (Boucher et al., 2020, Alan et al., 2021) and on teachers' prejudice (Alan et al., 2020).

Finally, we also contribute to the literature on contact theory from social psychology, which serves as our theoretical guideline and inspiration (Pettigrew, 1998, Pettigrew et al., 2011, Rivas-Drake et al., 2019). According to this theory exposing people to other ethnic groups should reduce prejudice. Our results suggest that consequences of exposing majority students to minority students are more nuanced and may involve agents other than students themselves. These external agents are for the most part omitted in contact theory. In our application we also find heterogeneous effects by type of minority (no response to exposure to Hakka students but negative behavioral responses to Indigenous students) suggesting that the *contact* may differ across minority groups. Furthermore, the negative behavioral adjustments are concentrated among parents and teachers rather than students, and are consistent with a reinforcement rather than amelioration of prejudice. On the other hand, for students we don't find any statistically significant responses and, if anything, conditional on the behavior of their parents and teachers it is positive indeed suggesting reductions in prejudice.

2 Institutional Setting

2.1 Education in Taiwan

Compulsory education in Taiwan starts with primary school at age 6 and ends with junior high school around age 15, however, approximately 95 percent of students continue their education with either General or Vocational Senior High School or Junior College. Figure A.1 provides a

schematic of the Taiwanese education system. The educational curriculum is developed centrally by the Taiwanese Ministry of Education and has no subject specialization during the compulsory stage of education. It is centered around sciences and mathematics which is often credited as the reason why Taiwanese pupils are consistently placed at the top on international educational rankings (e.g. 4th out of 72 countries in PISA 2015; Law (2004)). Since the 1990s, public junior high schools have been managed at the municipal level where in principle students can choose their preferred school. If the school is oversubscribed, however, the admission is based on a lottery system. We neither observe this source of random variation in our data nor use it for identification. Rather, we utilize the fact that conditional on admission to specific junior high school, students are randomly assigned to classrooms. This rule, critical for our identification strategy, is mandated by the central government and further extends to homeroom teachers (Dao Shi).[2] No exceptions to this rule are made based on demographic or socioeconomic characteristics. The assignment is permanent and, net of extraordinary circumstances like moving to a different municipality, students typically remain with their classroom and homeroom teacher throughout all three years of junior high school. In our data, we observe that 97% of students are in the same classroom and with the same Dao Shi at the beginning and the end of junior high school.

At the end of compulsory education, students take the National Basic Competence Test and its results determine competitive admissions to senior high schools and senior vocational schools. Consequently, students, parents and teachers spend considerable time, money and effort preparing for the exam. For example, schools regularly organize practice exams and other forms of preparation while parents are known to hire private tutors in mathematics, English and sciences. The latter is often facilitated through "cram schools" which are private extra-curricular institutions preparing specifically for high stakes centralized examinations.

2.2 Ethnic Minorities in Taiwan

The population of Taiwan is approximately 23 million, and is mostly inhabited by descendants of Han Chinese. According to the 2010 Census, 95% of the population was Han Taiwanese, 4% was Taiwanese Indigenous Peoples, and 1% of individuals were of other ethnicities (mostly immigrants from other Asian countries). At the same time, Han Taiwanese do not constitute a homogeneous group. While the vast majority of those are Hoklo descendants from Fujian (approximately 70%), there is a significant minority of Hakka descendants mostly from eastern

2. For legislative details see the Implementation Guideline for Class Assignment of Junior High School Students, later superseded by Article 12 of the Primary and Junior High School Act in 2004. Additional information can be found at http://edu.law.moe.gov.tw/EngLawContent.aspx. We do not have enough power in our data, mainly due to very small number of Indigenous teachers, to utilize the fact that homeroom teachers are also randomly assigned to their students and estimate ethnic complementarities between teachers and students.

Guangdong (approximately 15%).[3] We consider the former group as the ethnic majority, for whom we are interested in measuring outcomes, and the latter group as well as Indigenous Peoples as the two minority groups of interest. We provide a brief cultural and ethnographic sketch for each of the groups below but our choice was primarily motivated by the fact that both ethnic minority groups we consider have their own special representation in the government through the Council of Hakka Affairs and the Council of Indigenous Peoples, respectively. In that, the Taiwanese government itself recognizes and defines these individuals as ethnic minorities.

Hoklo are the ethnic majority people living in Taiwan. They are primarily descendants of people from southern Fujian who migrated to the island before the start of the Japanese occupation in 1895, with early migrations starting at the beginning of 17th century. They have the strongest sense of Taiwanese identity among the three Han Taiwanese groups. For example, in 1999, 75% of Hoklo identified as Taiwanese only while this share was 58% and 32% for Hakka and Waishengren, respectively (Tsai, 2007). Many Hoklo people are bilingual, and speak both Taiwanese Mandarin (the most commonly spoken language in Taiwan) and Taiwanese Hokkien. The latter is specific to Hoklo people and has distinct literary and colloquial layers of vocabulary so that it is not mutually intelligible with Mandarin. In our data 92% of Hoklo students are fluent in Mandarin and 41% of those students are additionally fluent in Hokkien.

Hakka are the first minority group we consider in this paper. They are primarily descendants of people who migrated from the Guandong province in the middle of 17th century, at the end of the Ming dynasty and the beginning of the Qing dynasty. They specialized in agriculture and mostly settled in Eastern and Southern provinces. Both in mainland China and historically in Taiwan, the Hakka faced discrimination from other Chinese ethnic groups that sometimes turned violent, leading to mass-killings in Hakka villages. They also speak a distinct language, Hakka, which is not mutually intelligible with either Mandarin or Hokkien. In our data, we see that 93% of Hakka minority children are fluent in Mandarin, and 15% of them are fluent in Hakka. On the other hand, very few non-Hakka Taiwanese students declare speaking the language. Table A.4 shows that Hakka and Hoklo have similar demographic and socioeconomic characteristics and, despite clear cultural differences, we view the two groups as being closer ethnically than either of those compared to Indigenous Peoples.[4] Hakka and Indigenous Peoples historically would also often ally against aggressors on Taiwan such as in 1867 against the Americans, in 1884 against

3. The remaining 10% of Han Taiwanese is Waishengren which defines people who migrated from mainland China to Taiwan between 1945 and 1949 during the relocation of the Republic of China government. Since this group is very heterogeneous, we include them in our ethnic majority sample but our results are not sensitive to this decision as documented in Section 5.2. If we consider them as a separate minority, we do not estimate any sizeable or statistically significant peer effects arising from exposure to Waishengren students. Throughout the paper, unless otherwise stated, we call "majority students" both Hoklo and Waishengren students.

4. Cultural differences resonate especially in food, architecture, arts and crafts but also in social behaviors and hierarchies. For example, Hakka historically put much emphasis on education making them "perfect bureaucrats" and they are the only Han ethnicity where women never bound their feet.

the French, and in 1907 against the Japanese.

Indigenous Peoples of Taiwan are the second minority group we consider. They are the native inhabitants of the island of Taiwan, and descend from those who lived on the island as far as 6000 years ago. Although there are many distinct tribes of Indigenous Peoples which generally have different histories and customs, the Taiwanese government officially recognizes 16 distinct ethnic groups within this broader ethnic umbrella. The share of Indigenous students among school-age children is about 4% but they are not distributed evenly across the country. Figure A.2 presents the fraction of 10 to 14 year old children who are Indigenous by county of residence. The vast majority of those children live in eastern parts of Taiwan, where their concentration is as high as 45%, but there is also a non-trivial share of Indigenous children living in counties surrounding Taipei - the capital. Akin to the two Han Taiwanese groups, the vast majority of Indigenous Peoples are fluent in Mandarin (91%), however, almost 30% are bilingual and also speak various indigenous languages. On the other hand, based on our data, virtually no Indigenous Children speak Hokkien or Hakka, and conversely almost no Hokkien or Hakka children speak Indigenous languages. As documented in Table A.4 Indigenous students are extremely disadvantaged compared to both Hoklo and Hakka.

3 Data

We use data from the Taiwanese Education Panel Survey (TEPS), a project jointly funded by the Ministry of Education, the National Science Council, and the Academia Sinica. The TEPS is a nationally representative longitudinal survey of the education system in junior high school, senior high school, vocational senior high school, and junior college. It is a multiple respondent survey, collecting linked information on students, parents, teachers, and school administrators.[5]

In this paper, we focus on the junior high school sample of the TEPS because it allows us to use measures of student ability and educational inputs paired with random assignment to classrooms in Grade 7. The TEPS junior high school sample includes information on more than 20,000 students, their parents, their teachers and their school administrators over two waves. The first wave was collected in early September 2001 at the very beginning of students' first year of junior high school, and right after their random assignment to classrooms within a school.[6] The second wave was collected in 2003, at the beginning of the students' last year of junior high school.

5. Although the sample is longitudinal, follow-up of the full panel is only possible between the beginning and end of junior high school which is what we use in this paper. We are unable to use subsequent waves of the survey due to selective attrition and much smaller sample sizes.

6. Although we cannot observe the difference between the admission roster and our post-randomization sample, due to strict regulation it is highly unlikely that students withdraw from school upon learning their assignment or between admission and randomization. To the extent that there is some selective dropout we should observe this in our balancing test.

There are three key features of TEPS that aid the design of our study.

First, its sampling framework allows us to observe a random sample of classmates in each junior high school classroom included in the survey. TEPS follows a stratified nested sampling procedure where first 338 randomly selected junior high schools were sampled (45 percent of all junior high schools in the country at the time), with sampling strata for urban and rural areas as well as public and private schools. In each of these schools an average of three classrooms of first-year students were then randomly sampled. In each of these classrooms around 15 students were then randomly sampled. Since the mandated maximum class size at the time was 35 students per class, this generally amounts to approximately observing a random half of the classroom.[7]

Second, students in the TEPS take a standardized test in waves 1 and 2 called the Comprehensive Analytical Ability test. This is a low-stakes test constructed for the purpose of the survey, it is anonymous from student perspective, and it has no bearing on their subsequent academic careers. It measures students' cognitive ability and analytical reasoning, and was specifically designed to capture gradual learning over time. The test contains 75 multiple-choice questions, covering general reasoning, mathematics, Mandarin and English. They were taken from an extensive bank of questions which includes adapted questions from other international standardized tests, as well as questions provided by education and field experts in Taiwan. The Comprehensive Analytical Ability test score, constructed as the sum of all correct answers, provides a measure of academic ability for students and their peers. Importantly, the tests are externally graded and the results of those tests are not disclosed to either students, parents, teachers or school administrators. Their main goal is for researchers to be able to accurately measure and study children's educational progress. We utilize the anonymity and low-stakes characteristics of the test as one of an important features in our analysis as it limits the possibility that teachers or parents might influence the results or that students might be differently affected by test taking stress itself.

Third, beyond cognitive outcomes, the TEPS provides a wealth of questions measuring student behavior, attitudes and beliefs in and outside the school environment, parent-child interactions and parental investments, as well as detailed information on teachers and school administrators. Many of these measures have multiple raters, combining questions asked to students, parents, teachers and school administrators. We aggregate all these questions to construct three indexes which measure student, teacher and parent inputs into the educational production function. Interestingly, teachers are also asked about their subjective assessment of each student's cognitive ability which we use as a contrast to the objective and anonymous measure generated by the

7. This sampling framework is similar to that of the National Longitudinal Study of Adolescent to Adult Health (Add Health), a panel study of middle and high school pupils in the United States. Add Health is unique in collecting friendship ties and in observing multiple cohorts of students in each school, which makes it particularly appealing for peer effect and networks research (see e.g. Agostinelli, 2018, Elsner and Isphording, 2017, Card and Giuliano, 2013, Bifulco, Fletcher and Ross, 2011, Calvo-Armengol, Patacchini and Zenou, 2009).

Comprehensive Analytical Ability test. The large set of inputs reported by multiple stakeholders allows us to comprehensively understand the production function at the classroom level, including its spillovers to the household environment.

Based on our data, we propose that changes in a student's classroom composition, and in particular exposure to ethnic minority students, could alter their educational choices and behaviors, their parents' investments and attitudes, and their teacher's perceptions and subjective assessments. For example, in our data Indigenous students have on average 91% of a SD lower test scores compared with non-minority students and thus it could be that the latter might study less when exposed to relatively weaker peers. On the other hand, their parents might try to compensate for this perceived negative peer composition by increasing private tutoring; while teachers in these classrooms might be less effective if they need to tailor the instructional practices to students with vastly heterogeneous academic ability. Since all inputs are measured using multiple questions, we first identify entire blocks of items in the questionnaires of all respondents—e.g. blocks of items related to study effort reported by students, parents and teachers. We eliminate very low correlates to maximize the informational content of each index and reduce noise. To do this, we compute Spearman correlations between all items under consideration, assess their Cronbach's alphas, and perform an exploratory factor analysis. Once we narrow down the list of items for a scale, we perform an additional confirmatory factor analysis to validate these items and ensure their item factor loadings have similar magnitudes. Finally, for each of these potential mediating factors and in each wave, we perform PCA analysis and select first component of PCA to generate the three final indexes. Tables A.1 to A.3 present results from this PCA analysis for student, parent, and teacher indexes, respectively, along with their eigenvectors and eigenvalues. Each input in each table was first constructed based on confirmatory factor analysis. We present alternative approaches to constructing these indexes, namely simple summation of factors or regression-based prediction, in Section 5.2.

We construct an index of student behaviors through five scales of study hours, school effort and initiative in class as perceived by teachers, truancy, academic self-efficacy, and mental health, and three additional dummies for whether students ever cheated on exams, aspire to go to university, and expects to be able to go to university. Effort and initiative are often considered as potential mechanisms for academic peer effects (see e.g., Feld and Zoelitz (2017) or Xu, Zhang and Zhou (2022)). Our data allows us to differentiate between study time outside the classroom and student engagement in the classroom, as measured by initiative. We analyze effort as perceived by teachers since it can be influenced by peers for different reasons (e.g., through relative performance benchmarking by teachers) and could also be capturing other types of investments (e.g., if teachers focus on specific students based on their relative perceived effort). Mental health and academic self-efficacy could be affected positively if minority peers help foster inclusive atmosphere in classroom or negatively if they generate conflict, disruption, or if students witness discrimination of their colleagues. Similar reasons could drive positive or negative responses in exam cheating and truancy. Finally, non-cognitive skills such as aspirations and expectations

about one own ability have been shown to be partially formed by social interactions and to be productive for academic achievement (Carlana, La Ferrara and Pinotti, 2022).

We construct an index of parental behaviors and investments through four scales of private tutoring, time spent with parents, parental strictness and parental support, and three additional dummies for whether parents have conflicts with their child, use harsh punishment/parenting, and aspire for their child to go to university. School environment has been shown to affect parental investments and academic achievement (see e.g., Pop-Eleches and Urquiola (2013) or Fredriksson, Öckert and Oosterbeek (2016)), and much of this work postulates peers as a key driver of these effects (see e.g. Pop-Eleches and Urquiola (2013) or Jackson (2013)). Furthermore, monetary and time parental investments are the canonical Beckerian household investments in human capital and can therefore respond as complements or substitutes to school inputs, such as exposure to minorities in classroom. Parental strictness, support, and harshness belong to a broader set of parenting styles which can also be modelled as parental investments (Cobb-Clark, Salamanca and Zhu, 2019) and thus also react to school inputs for similar reasons. Conceptually, strictness is close to parental monitoring, which can be an important margin in this context, whereas support is closer to warmth and more generally measures parental engagement. Harshness is also not uncommon in this context, and can be a margin of reaction for parents if they see it as a way to ensure their children's school performance. We see parent-child conflict as a potential outcome of all these interactions which can in itself affect student outcomes. Finally, parents' aspirations for their child to go to university can in themselves drive student outcomes (Janzen et al., 2017) and could proxy for other unmeasured inputs (e.g., parental encouragement).

Lastly, we construct an index of teacher behaviors based on a scale of teacher engagement, frequency of parent-teacher meetings, a scale of teacher mental distress, a scale of teacher use of modern teaching practices, the teacher's assessment of the classroom's academic level compared to other classrooms in the same grade, and finally a dummy variable for whether teachers report that the classroom is hard to manage. We might expect students exposed to more diverse classrooms to have a more positive experience in school (Feld and Zoelitz, 2017, Booij, Leuven and Oosterbeek, 2017), or to feel marginalized (Pop-Eleches and Urquiola, 2013). Furthermore, lower-achieving peers such as Indigenous students might increase classroom disruption, making classroom management harder and decreasing teacher engagement (Duflo, Dupas and Kremer, 2011). Ultimately, teachers might feel more motivated and less tired of teaching when working with a more homogeneous classrooms with fewer minority students.

Table A.4 presents basic descriptive statistics for the full TEPS sample (column 1), our estimation sample (column 2), and then for the three ethnic groups we consider in the paper: Indigenous students (column 3), Hakka students (column 4), and Hoklo and Waishengren students (column 5). The first set of variables presents student characteristics, the second set parental characteristics, and the third set school characteristics. Comparing the first two columns suggests that our estimation sample is very similar to the full data set or if anything it is slightly positively

selected.[8] Thus, our estimates should be externally valid to the full population of Taiwanese schools. This table further makes it clear that Indigenous students are much more disadvantaged than either Hakka or majority students. Their baseline test scores are over 90% of a SD lower than those of the majority and they also come from larger families (2.4 siblings vs 1.7 for the majority) with less educated parents (80% of parents with at most high school vs. 64% for the majority) who have lower incomes (30% in lowest income bracket vs. 9% for the majority). Interestingly schools attended by Indigenous students are about half as likely to have principal with postgraduate degree compared with the majority students but years of experience of the principals is comparable. This could reflect the fact that Indigenous Peoples in Taiwan cluster in more rural areas rather than in the largest cities. Furthermore, these striking differences highlight the value added of our random assignment. On the other hand, Hakka and majority students are very similar to each other when it comes to demographics. The main difference present across all three groups is in their ability to speak language other than Mandarin which we take as a proxy for cultural differences. Namely, almost no majority students are fluent in either Hakka or Indigenous languages. Likewise Hakka students do not know Indigenous languages and Indigenous students do not know Hakka. Importantly, across the three groups about 90% of students are fluent in Mandarin.[9]

4 Empirical Strategy

4.1 Estimating Equation

In order to estimate effects of exposure to minority students in classroom we follow peer effects literature and use linear in means models. Specifically for test scores we estimate:

$$Score_{iscw_2} = \alpha_1 + \alpha_2 \overline{\%Indigenous^{-i}_{iscw_1}} + \alpha_3 \overline{Hakka^{-i}_{icsw_1}} + \delta \mathbf{X}_{iw_1} + \gamma_{sw_1} + \varepsilon_{iscw_1} \qquad (1)$$

where i indexes students, s indexes schools, c indexes classrooms, w_1 indexes start of grade 7 (baseline) while w_2 indexes start of grade 9 (when we measure outcomes). Coefficients of interest in Equation 1 are α_2 and α_3 representing causal effects of exposure of the majority students to share of Indigenous and Hakka students randomly assigned in the baseline grade. We also include control variables measured at the baseline to reduce noise in our relatively small sample

8. The difference between these two columns comes primarily from the fact that we drop schools which are likely to be exempt from following random assignment policy e.g., schools specializing in arts.

9. Lower test scores observed for Indigenous students could explain why they are somewhat less likely to be fluent in Mandarin compared to ethnic majority students. We consider language fluency as one of our mediators later in the analysis.

sizes ($\mathbf{X}_{iw_1}$) and baseline school fixed effects (γ_{sw_1}) since our randomization is across classrooms (c) within schools (s). The control variables include baseline test scores and thus our main results have a value-added interpretation i.e., how much more students in classrooms with more vs. less minorities learn by grade 9 conditional on what they already knew in grade 7. Since in the main specifications we run these regressions on a full sample of students, rather than just on the majority, we control for student's own minority status and its interaction with the share of the two minorities we consider. We cluster the standard errors at the level of the classroom in wave 1, since this is the level of randomization.[10]

When considering indexes of student, parental, and teacher behaviors as dependent variables in select specifications we modify Equation 1 slightly. First, we do not control for student baseline test scores. Second, we include measures of these outcome variables at the baseline in grade 7. In that, causal effects from these regressions can likewise be interpreted in a value-added sense where, for example, we measure how the amount of parental investments changed between grades 7 and grades 9 conditional on their investments made up to grade 7. We discuss various permutations of these preferred specifications in Section 5.2.

4.2 Identifying Assumption: Random Assignment to Classrooms

Our identification strategy exploits institutional feature of Taiwanese junior high schools where students are randomly assignment to classrooms. Random assignment to peers is the main identification assumption under which our estimates can be interpreted as causal effects of exposure of the majority students to Indigenous and Hakka minorities. Therefore, we first show that our treatments of interest – classroom leave-out-means of Indigenous and Hakka students – are as good as randomly assigned.

We start by running balancing tests on standardized test scores in wave 1, eight baseline characteristics and eight pre-assignment educational characteristics. Baseline characteristics include student gender, whether they were born prior to 1989, whether they live in a two-parent household, whether their household income is above median (NT$50,000 monthly, equivalent to roughly US$1,500 in 2001 dollars), whether they live in a household with at least one stable source of income, whether their parents have at most a high school degree, whether the father is employed, and finally whether at least one parent has a self-reported good health status. Pre-treatment educational characteristics are measured using retrospective questions asked at the baseline, covering the student's outcomes up to a junior high school, such as behavior and health during primary school, attitudes to school and homework since primary school, and family investments in tutoring and homework before junior high school.

10. Our conclusions remain unchanged if we instead cluster at school-level allowing correlated errors across classrooms, or if we consider empirical p-values based on randomization inference.

Thus, in total we test balance in 17 characteristics for two variables of interest yielding 34 tests. Given the number of comparisons we are doing we would expect to see at least three coefficients to show up as statistically significant at 10% level due to pure chance. Table 1 presents these results and we find only two coefficients statistically significant at 10% level.[11] It appears that in classrooms that are randomly allocated higher share of Indigenous students majority fathers are somewhat more likely to be employed while in classrooms that are randomly allocated higher share of Hakka students majority parents have higher likelihood of having income above median. This, if anything, would imply positive selection into classrooms with higher share of minorities rendering our negative effects conservative. However, note that even these significant coefficients are quantitatively small when compared to the baseline means of their respective dependent variables. Furthermore, all the remaining non-significant coefficients are likewise small and relatively precisely estimated. We also test all the covariates jointly through sorting assessments proposed by Guryan, Kroft and Notowidigdo (2009) and Jochmans (2022). In neither case we can reject the null hypothesis of no systematic sorting. Together, we take both of these exercises as evidence of compliance with the mandate of random assignment of students to classrooms within schools and in support of our identifying assumption.

5 Results

5.1 Test Scores

Having established that our identifying assumption is likely to hold, we first estimate the effects of exposure to minority peers on academic achievement of the majority students. The results are presented in Table 2 where akin to Table 1 we scale all the coefficients by a one SD increase in classroom share of either Indigenous or Hakka peers. We have three main findings stemming from this table. First, conditional on own test scores measured at baseline, additional controls do not affect our point estimates of interest. This is expected given the balance we have documented in Table 1 – this, again, supports our identifying assumption. At the same time, there is a small difference in effect sizes between column (1) where we do not control for own test scores and subsequent columns where we do. This is likely due to a very strong correlation between test scores in waves 1 and 2 and a relatively low correlation between share of minorities and wave 1 test scores (as documented in Table 1). Since the omitted variables bias formula multiples these two correlations, even a small imbalance in baseline test scores would be magnified by a strong

11. Estimates are scaled by one within-school standard deviation change in the share of of minority students in the classroom. One standard deviation in the share of Indigenous students is 0.047, equivalent to having 1.7 more Indigenous children in the classroom. One standard deviation in the share of Hakka students is 0.077, equivalent to having 2.8 more Hakka children in the classroom. Sample sizes differ across outcomes due to missing values. Conclusions are unchanged if we force the sample to be balanced across outcomes.

correlation between wave 1 and wave 2 test scores. Overall, we view the point estimates of -0.014 and -0.016 as qualitatively identical, and more importantly, including baseline test scores meaningfully shrinks the standard errors on our estimates of interest.[12] Second, irrespective of the specification, we find negative peer effects from exposure to Indigenous students and no negative effects of exposure to Hakka students. In three out of four specifications, those where we improve our statistical power by conditioning on baseline test scores, we can also reject the equality between the two peer effects coefficients. Third, the interaction terms in the last column of the table do not indicate that increased shares of minorities in the classroom help minority students themselves. These estimates, although positive, are not statistically significant at any conventional level. We do acknowledge, however, that the point estimate suggests a negative peer effect for Indigenous students reduced by about 25%.

Overall, these results suggest that Hoklo and Waishengren majority students have about 1.9 percent of a standard deviation lower test scores per one standard deviation increase in share of Indigenous students in their classroom, where a standard deviation in share of Indigenous students represents 1.7 children. In our data 56% of classrooms have no Indigenous children, 29% have just one child while 15% have more than one child. Thus, adding one Indigenous child to the typical classroom of 35 students would increase the share of Indigenous peers by at least 2.9%, which translates into a negative effect of 1.1% of a standard deviation. Although it is small, this average effect would apply to the overwhelming majority of students in Taiwanese schools, hence its aggregate effects should not be understated. At the same time, using 95% confidence interval, we can rule out negative Hakka effects of as little as 0.9 percent of a standard deviation.

To put these estimates into context it is worth highlighting that prior results in the literature have been both limited and mixed; and no prior study was able to exploit random assignment of minorities to either schools or classrooms. Angrist and Lang (2004) as well as Figlio and Özek (2019) do not find any negative effects on cognitive abilities of native/majority students exposed to racial minorities or immigrants, respectively. Setren (2022) re-examines the METCO program first evaluated by Angrist and Lang (2004) and likewise finds no negative peer effects on academic performance, classroom behavior, and attendance of suburban students. On the other hand, Figlio et al. (2021) actually find that an increase in immigrants at school, from 10th to 90th percentile, increases native student's test scores in mathematics and reading by 2.8 and 1.7 percent of a standard deviation, respectively. More in line with our findings, Hoxby (2000) documents that for every 10 percentage points increase in share of Black students in classroom third grade reading test scores fall by 0.25, 0.10, and 0.06 points for Black, Hispanics, and Anglo students, respectively.[13] Our Indigenous effect sizes are comparable to Hoxby's estimates for Anglo

12. Specifically the point estimate increases by about 15% while the standard error decreases by about 30%.

13. Standard deviation of this test score varies between 2.1 and 2.6 depending on the exact year (Table 2 in Hoxby (2000)). Therefore, it implies effect sizes between 2.3 and 11.9 percent of a standard deviation depending on the race and what standard deviation we use.

students and are much smaller than estimates for Black and Hispanic students. The only other study that finds negative effects, Diette and Oyelere Uwaifo (2014), shows that a 10 percentage point increase in limited English students lowers mathematics and reading scores of native students by about 0.7 percent of a standard deviation. Overall, our zero Hakka estimates square with some prior findings, however, our negative Indigenous Peoples estimates are economically comparable to some of the Hoxby (2000) effect sizes.

We also investigated heterogeneity in our estimates along three dimensions: student gender, student ability, and family socioeconomic status. Our interest in gender stems from two recent research insights. First, Autor et al. (2019) among others suggest that boys may be particularly sensitive to inputs and in particular to school inputs (Autor et al., 2016). To the extent that this is true, and indeed there is differential gendered-productivity of inputs, then any changes in parental or teacher investments in response to exposure to Indigenous peers might be more consequential for boys than for girls. Second, there is evidence in the literature that parents might invest different amounts of resources into their sons and daughters (Raley and Bianchi, 2006, Karbownik and Myck, 2017); research in Asian societies specifically suggests that parents underinvest in daughters (Parish and Willis, 1993, Das Gupta and Li, 1999). In this case, we'd expect more negative effects for female compared to male students. Student ability is of interest given the long-standing literature on ability peer effects (see de Gendre and Salamanca (2020) for discussion of ability peer effects in the Taiwanese context and Sacerdote (2011, 2014), Paloyo (2020) for overviews of the literature) and the fear (of parents) that high ability ethnic majority children could be harmed by exposure to relatively lower ability minority students –a major pushback against school integration in many jurisdictions worldwide. When it comes to family resources, on the one hand, it is plausible that constrained households could reduce their investments more if their limited resources can be spent more productively elsewhere. On the other hand, in resource-constrained households the effects might be muted if these parents do not have much resources to invest in their children in the first place. This is a similar argument to the one put forth by Karbownik and Özek (forthcoming) in their explanation for within-family sibling spillovers generated by the school starting age policy in Florida. We divide households either by family income or by median of predicted parental ability.[14]

Table A.5 presents these results where we also provide three sets of p-values: for whether Indigenous and Hakka effects in subgroups are equal and separately for the two minority groups whether the coefficients across the groups on which we split are statistically identical or not. Akin to our main results from Table 2, irrespective of a chosen group, we do not find any statistically

14. We proxy for parental ability by 1) regressing student test scores in wave 1 on all our parental investment measures in wave 1 (tutoring, time, conflict with child, strictness, support, harsh parenting, and high aspirations) and school fixed effects, then 2) applying the coefficients of that regression (while ignoring the fixed effects estimates) to the corresponding parental investment measures in wave 2 to get "forecasted scores", and then 3) categorizing low (high) parental ability types depending on whether these forecasted scores are below (above) the median.

significant or sizeable effects of exposure to Hakka minority. On the other hand, we uncover a degree of heterogeneity when it comes to exposure to Indigenous peers.[15] In particular, we document that the negative effects are larger for boys, high-achieving students, and those coming from more affluent households. The gendered finding is consistent with differential responses of boys to inputs but not with differential investment levels which tend to favor boys rather than girls in Taiwan (Parish and Willis, 1993). Thus, if anything, our negative effect for boys is an underestimate for the effects expected in societies with more gender-neutral attitudes.[16] Larger negative effects for low-achieving students, this difference is statistically significant at 5% level, do not appear to be driven by meaningful differences in parental inputs. Rather, reductions in teacher and school inputs appear to be larger for high-performing students while low-performing students increase their effort and investments (Table A.6). This is consistent with teachers reallocating their attention from high- to low-performing students. Finally, the larger effects in households with more resources appear to be driven by differential parental investments and differential teacher and school investments; although we generally cannot reject the significance of these coefficients across the affluence groups. Irrespective how we measure household resources, reductions in parental investments are larger in lower SES households while reductions in teacher and school inputs are larger for students coming from higher SES households.

5.2 Robustness

Having presented our main results, we now document that they are robust to alternative specifications. In all of the sensitivity analyses we focus on fully saturated model from column 4 of Table 2 but we only display coefficients on Indigenous and Hakka peers. We start our analysis by exploring the stability of our preferred estimates over alternative sample choices. Table A.7 presents these results. Column 1 replicates our baseline results from column 4 of Table 2 while column 2 drops majority Hakka and Indigenous schools where we might expect more muted peer effects. In column 3 we exclude Indigenous and Hakka students from the sample, also dropping ethnic indicators and their interactions with the share of ethnic minority students. In column 4 we drop all private schools which we worry might be less likely to follow the governmental rules on random assignment to classrooms, or more likely to cater to a more select set of students and parents. Finally, in column 5 we exclude Waishengren students from our definition of what constitutes ethnic majority in schools as these students are culturally difference from Hoklo.

15. In Table A.6 we present heterogeneity analyses for the mechanisms which we briefly discuss here rather than in Section 5.4 as it is informative for understanding the heterogeneity in test score effects. For brevity, we only report the results for Indigenous peers; as similar to our test score results, we do not detect any heterogeneity in mechanisms when it comes to Hakka peer effects.

16. Table A.6 documents that reductions in parental and teacher inputs are comparable across genders and that if anything girls in classrooms with higher shares of Indigenous peers increase their effort (although this coefficient is not statistically significant at conventional levels) while boys' effort is unaffected.

Irrespective of the sample we choose, we find very consistent results –negative, statistically significant, and similar magnitude-wise estimates for Indigenous peers and never statistically significant and small coefficients for Hakka peers.[17] Based on these exercises we conclude that our main results are robust to reasonable alternative definitions of estimation samples.

Next we consider definition of our treatment variables. Our preferred measure is a standard deviation of minority peers in the classroom, but this might be misspecified. Thus, in Table A.8 we present two alternative ways of defining our treatment: the share of specific minority students in the classroom (column 2) and the presence of any student from a specific minority group capturing the extensive margin of the treatment (column 3). The results when using the share of students are substantively unchanged. The coefficients increase in size, which makes sense given that we changed the definition of the treatment variable, but this change is proportional for both Indigenous and Hakka peers. Namely, both coefficients increase by a factor of approximately 16. Since the fraction of Indigenous students in the overall Taiwanese population is about 4%, this means that randomly distributing them into classrooms in Taiwan would produce a negative effect of 1.6% of a SD. Restricting the distribution to only schools with at least one Indigenous child –implicitly increasing the Indigenous share in these schools to 6.9%– would yield a negative effect of 2.8% of a SD.

Given the relatively small share of Indigenous students in population, it is perhaps more policy relevant to ask if having exposure to any Indigenous peer – at the extensive margin – would also generate negative effects similar to those that we estimated using the share or standard deviation of Indigenous peers. When we use a dummy variable for any Indigenous peer in the classroom we find a negative point estimate of 4.8% of a standard deviation. This effect is about 2.5 times the size of our estimate in column 1, suggesting non-linearity and diminishing penalty over subsequent Indigenous students.[18] Interestingly, on the extensive margin, we also find a negative and statistically significant penalty from exposure to Hakka peers that is only somewhat smaller than the penalty from exposure to Indigenous peers. Given that our estimates in columns 1 and 2 for Hakka are positive, this suggests that the penalty from Hakka peers might be strongly decreasing in size of this peer group, which, in many schools, is much larger than the group of Indigenous students due to the fact that Hakka students constitute about 16% of the Taiwanese population rather than just 4%. This intuition is confirmed by estimates in Figure A.3 where we

17. Interestingly, in sample where we exclude Waishengren student (column 5) the coefficient on the interaction between share of Indigenous peers and being Indigenous is positive and marginally statistically significant at 10% level. At 0.7% of a standard deviation it means that negative peer effect for Indigenous students is halved compared with Hoklo majority students.

18. We have also estimated models with indicators for just one, just two, and three of more Indigenous students in the classroom. The results, presented in Figure A.3 suggest increasing penalties with more students but only up to two students. The point estimate for three or more Indigenous students is smaller but statistically insignificant with large standard errors. This is likely due to very limited set of classrooms that would have more than three Indigenous students. Recall that in our data 76% of classrooms do not have any Indigenous students, 16% have one, 3% have two, and only 5% have three or more such students.

estimate a penalty of 5.3% of a standard deviation in classrooms with just one Hakka student while it declines to 3.4% and trivial 0.5% of a standard deviation for classrooms with two or three or more Hakka peers, respectively. Our interpretation of these non-linear results are that being the "only different child" in a classroom could generate negative peer effects irrespective of child's ethnicity. It just so happens for statistical reasons in the context of Taiwan that for a non-trivial fraction of classrooms Indigenous students are more likely to be the "only different child" of their ethnicity.

Our final robustness check pertains to verifying that our results are not driven by departures from random assignment to classrooms or quantitatively important spillovers across classrooms. To study this we perform a series of placebo estimates where we randomly re-assign Indigenous and Hakka peers across classrooms. We perform this reallocation 1,000 times and under un-confoundedness assumption expect to get normal-looking distributions centered around zero.[19] Figure A.4 presents these results confirming our intuition. An additional benefit from this exercise is that such procedure allows for construction of exact tests (Young, 2019) and thus provides an alternative way of calculating p-values for hypothesis testing. Indeed, the aforementioned figure reaffirms our statistically significant negative peer effect for Indigenous students (empirical p-value of 0.005) and no statistically significant effect for Hakka students (empirical p-value of 0.530).

5.3 Alternative Explanations

As a transition between robustness checks and mechanisms we first verify to what extent our estimates are driven by characteristics correlated with indigeneity. Table A.4 makes it clear that Indigenous students have lower ability, are less fluent in Mandarin, and come from more disadvantaged households. Given the literature on ability peer effects (e.g., Lavy, Silva and Weinhardt (2012)), the importance of language skills in schooling (e.g., Boucher et al. (2020)), and the effects of disadvantage in generating peer effects (e.g., Carrell, Hoekstra and Kuka (2018)) we need to ensure that our peer effects are indeed due to the indigeneity of these students rather than due to any other correlated characteristics. We acknowledge, however, that the decompositions presented below, unlike our main estimates, do not have a causal interpretation and should be treated as a descriptive and exploratory findings only. Since we have not found any meaningful effects of exposure to Hakka minorities, we omit them in this and subsequent analyses.[20]

19. If there are departures from original random assignment or spillovers across classrooms then we would expect more positive or negative coefficients than a chance would have suggested ultimately leading to a distribution departing from normal.

20. It may seem unintuitive to try to explain a zero effects. Nonetheless, we run all the regressions with share of Hakka peers. Unsurprisingly we do not find any effects of either correlates of Hakka status or any effects on changes in parental or teacher behaviors studied in the next section. These zero effects are consistent with zero effects we find

To answer this question we use the a method proposed in Gelbach (2016). We adjust this method to accommodate the inclusion of fixed effects, which we need since our randomization is performed at classroom-level within schools. Importantly, unlike other decomposition methods, this one is not sensitive to ordering of the explanatory variables and takes into account correlations between them. Specifically, we only use within-school variation and compute the following equation for each input k:

$$\underbrace{ME}_{\substack{\text{total}\\ \text{mediated}\\ \text{effect}}} = \sum_k \underbrace{ME_k}_{\substack{\text{input } k\\ \text{contribution}}} = \sum_k \underbrace{\frac{\partial S_{ics2}}{\partial y^k_{ics2}}}_{\substack{\text{input } k\\ \text{average return}\\ \text{on scores}}} \times \underbrace{\frac{\partial y^k_{ics2}}{\partial \bar{S}^{-i}_{cs1}}}_{\substack{\text{peer effect}\\ \text{on input } k}}$$

where k includes Indigenous test scores in wave 1 , Indigenous fluency in Mandarin language, a composite score of socioeconomic status of Indigenous students household, and a composite score of behaviors and investments of Indigenous parents. The parental composite index is the same that we explore in the subsequent analysis but for Indigenous rather than majority parents.

Table 3 presents these results and shows that socioeconomic status and differential investments of Indigenous parents do not explain any of the negative effect on the majority students test scores. On the other hand, lower test scores and Mandarin fluency of Indigenous peers can explain part of the uncovered effects. Together these two correlates account for about 1/3 of the estimated negative effect meaning that the majority of the effect is due to indigeneity itself or endogenous responses of students, parents, and teachers to Indigenous status of minority students. Overall, we conclude that although characteristics correlated with indigeneity (or for that matter potentially other minorities status in different settings) should be accounted for, they are not the predominant factor driving the negative human capital effects documents in Table 2.

5.4 Student, Parental, and Teacher Behavioral Changes

We now turn to another set of mechanisms that could potentially explain the documented negative peer effect. In particular, we propose that differential behaviors of ethnic majority students, their parents, or teachers in classrooms with Indigenous students may be responsible for these effects. We conduct this analysis in two steps. First, we substitute our dependent variable with indexes of student, parents, and teachers behaviors described in Section 3. In this analysis, like with test scores, higher values of the index are better meaning that negative estimates correspond to less desirable behaviors. Importantly these indexes are positively and significantly correlated with test scores and thus at least in cross-section they should be viewed as productive inputs. Here we also add an estimate for subjective assessments of students cognitive outcomes by their teachers.[21]

on test scores in Table 2. We omit reporting them for brevity.

21. The developmental assessment score is constructed based on 10 questions answered by student's Dao Shi. The questions ask them to assess the student on a 5-point scale going from *Poor* to *Excellent* on the following aspects:

We study this additional outcome hypothesizing that perhaps parents might underinvest in their children because teachers report, based on their overall opinion about the classroom which in itself could be influences by Indigenous students, that their child is performing sufficiently well in schools. Such a finding would be consistent with reference-dependent preferences where agents exert more effort if expectations are high compared to setting when they are low (Abeler et al., 2011). Second, akin to results presented in Section 5.3, we use Gelbach (2016) decomposition to descriptively understand to what extent these changes in student, parent, and teachers behaviors could explain our negative peer effects.

Table 4 presents the results for the first part of the analysis. Consistent with our prediction other agents, thus far mostly ignored in the extant literature, appear to matter in the production function as we find that in classrooms with higher share of Indigenous students ethnic majority parents exhibit negative behavioral changes.[22] Why would parents lower their investments in such classrooms? For example, it could be that ethnic majority parents perceive these classrooms as weaker and thus decide to spend their resources elsewhere (perhaps on their other children). On the other hand, a point that we come back to below, perhaps they get an incorrect signal from the teacher about the (relative and subjectively assessed) performance of their child and believe that they don't need additional time and money investments.

Likewise, we find negative effects on teacher behaviors.[23] On the other hand, we do not find any statistically significant effects on either student behaviors (coefficient 3 and 6 times smaller than parental and teacher estimates, respectively) or on teacher's subjective assessment of student's ability. The former suggests that the observed peer effects are unlikely to be caused by students themselves – a prevalent hypothesis behind the origin of peer effects literature – due to either their characteristics or actions. Rather, they occur because of changes in behaviors of parents and teachers. The latter finding suggests that perhaps teachers in classrooms with higher fractions of Indigenous students tend to evaluate the ethnic majority students overly favorably. Of course, this favoritism would not be captured by the test scores as teachers cannot influence them and don't actually know how their students performed. Although we are unable to discern if teacher's subjective assessment is a causative factor behind changes in parental behaviors or if these two

mental maturity, computer operation skills, oral presentation skills, writing skills, cooperation with other students to complete task, leadership, the ability to independently collect and organize materials, abstract and logical thinking ability, problem solving ability, motivation to study. Thus, this measure is more holistic that cognitive test scores which we use as our primary outcome. Nonetheless, the two measure are highly positively correlated (Pearson correlation coefficient of 0.53) and the score is certainly meant to reflect student's cognitive ability to a certain degree.

22. When we investigate specific components of the index we find that the negative effect is driven by lower spending on private tutoring, lower university aspirations, and less time spend with their children. We prefer to present the aggregated index results rather than its separate components since given their number those do not survive adjustment for multiple hypothesis testing (Clarke, Romano and Wolf, 2020). Thus, the analysis of specific components for each index should be treated as exploratory.

23. This index is primarily driven by teachers having lower average assessment of class ability and reporting that such classrooms are harder to manage.

occur in parallel, it certainly seems plausible that no negative feedback from a teacher could change reference point of student's parents and alter their investment behaviors.

We now ask if these changes in behaviors matter for the estimated peer effect. Table 5 presents these results.[24] Since student, parental, and teacher behaviors are correlated and Gelbach (2016) method accounts for this interdependence the coefficients change somewhat compared to those from Table 4. In particular, coefficient on student-related mediators flips the sign and becomes positive albeit statistically insignificant. This means that conditional on parental and teacher behavioral changes, if anything, student behavior improves in classrooms with higher share of Indigenous students potentially offsetting the negative peer effect. On the other, we consistently find negative and statistically significant coefficients for parental- and teacher-related indexes which means that part of the negative peer effect can be explained by the decline in behaviors of these two groups. How much of the effect can we explain? Table 5 suggests that almost 2/3 of the negative peer effects could be due to changes in behavior of students, parents, and teachers and this is about twice the amount that was explained by characteristics correlated with indigeneity discussed in Section 5.3.

Taken together these results support the notion that peer effects in schools should be modelled in the context of multi-factor production function while researchers should consider endogenous changes in behaviors of other agents such as parents or teachers (and perhaps also administrators which we cannot observe in our data) as potential explanations for the effects they uncover. Our results certainly suggest that direct peer effects explain a rather small part of the effects documented in Section 5.1. This further suggests that a non-trivial share of the estimated effect is due to indigeneity itself which leads to changes in behaviors of parents and teachers.

Our final analysis combines the decomposition results presented in Tables 3 and 5 and asks if we can fully explain away the negative peer effect documented in Table 2 by accounting for correlated student characteristics as well as endogenous responses of students, parents and teachers. This is likewise a descriptive exercise and Table A.9 presents these results. First, it is worth highlighting that including pre-assignment controls (conditional on including wave 1 test scores) does not alter the point estimates – comparing columns 1 and 2 – which provides further support for validity of our identifying assumption discussed in Section 4.2. Thus, pre-assignment controls have no explanatory power when it comes to the causal effects we document in this paper. Including correlated peer characteristics (column 3) explains 26% of the estimated negative effect but it remains statistically significant at 10% level. This is somewhat smaller but certainly within the same range as the results produced by Gelbach (2016) decomposition in Section 5.3.

24. Here we do not include teacher's subjective assessment of student's ability in the teacher-related mediators. On one hand, these two measures are highly correlated and should capture approximately the same concepts. On the other hand, they provide two independent assessments data points when it comes to student ability. Thus, ex ante, it is not clear if we should include teacher's subjective assessment in this analysis.

At the same time, including student, parent, and teacher indexes (column 4) more than halves the negative peer effect and renders it no longer statistically significant. Finally, conditioning of both of these plausible mechanisms (column 5) explains away almost all of the negative coefficient and making it effectively zero. Even though this is a descriptive exercise, we conclude that much of the negative peer effect documents in Section 5.1 is due to endogenous responses of parents and teachers (more important) as well as characteristics correlated with indigeneity (less important) which means that correcting these two uncovered mechanisms could reduce any negative spillovers occurring due to classroom integration to zero.

6 Conclusions

This paper shows that minority peers can have negative effects on cognitive outcomes of the majority children and that these negative externalities can be group-specific even within the context of a single country and education system. We find that classroom exposure to Indigenous peers lowers test scores of ethnic majority students by 1.9% of a standard deviation per one standard deviation increase in number of Indigenous students. We do not find any statistically significant or economically meaningful peer effects from the other minority group we consider - Hakka. Furthermore, we document that a non-trivial share of the negative effect can be explained by changing behaviors and investments of majority parents as well as teachers in these classrooms. On the other hand, characteristics correlated with indigeneity can account for a smaller fraction of the estimated coefficient. In that, the negative effect should not be attributed to the ethnicity of students per se but rather to how others react when interacting with ethnic minorities. Thus, successful classroom integration efforts need to better understand and address these endogenous responses of parents and teachers which have largely been ignored in the peer effects literature to date.

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Tables

Table 1: *Balancing Check*

Treatment:		+1SD in classroom Indigenous peers		+1SD in classroom Hakka peers		
	Mean	Coef.	Std. err.	Coef.	Std. err.	Obs.
Outcomes: Pre-assignment characteristics						
Student test scores in wave 1	Std	0.004	(0.011)	-0.001	(0.009)	16,262
Female student	0.49	-0.000	(0.005)	0.005	(0.004)	16,262
Student born before 1989	0.37	0.003	(0.005)	-0.002	(0.003)	16,218
Two-parent household	0.91	-0.001	(0.003)	-0.002	(0.002)	16,242
Household income > NT$50k/mo.	0.49	-0.004	(0.005)	0.007*	(0.004)	16,181
Stable income for 1+ household member	0.91	-0.001	(0.003)	-0.001	(0.002)	16,230
Parent(s) education is high school or less	0.65	-0.008	(0.005)	-0.002	(0.004)	16,262
Employed father	0.90	0.006*	(0.004)	0.000	(0.002)	15,725
Parent(s) in good health	0.61	-0.000	(0.005)	-0.001	(0.003)	16,256
Prioritized studies since primary school	0.27	0.005	(0.004)	0.001	(0.003)	16,187
Reviews lessons since primary school	0.18	0.002	(0.004)	-0.001	(0.003)	16,171
Likes new things since primary school	0.42	0.000	(0.006)	0.005	(0.004)	16,144
Was truant in primary school	0.33	0.004	(0.004)	-0.001	(0.003)	16,214
Student had mental health issues in primary school	0.48	-0.001	(0.004)	0.003	(0.003)	16,212
Had private tutoring before junior high	0.69	0.003	(0.006)	-0.001	(0.003)	16,094
Family help with homework before junior high	0.84	0.001	(0.004)	-0.002	(0.003)	15,482
Student quarreled with parents in primary school	0.67	-0.002	(0.004)	0.004	(0.003)	16,231
Guryan et al. (2009) sorting t-statistic		1.1		0.9		
Jochmans (2020) sorting t-statistic		1.0		1.0		

*Note: This table reports estimates of regressing pre-assignment characteristics in wave 1 on the classroom share of Indigenous and Hakka peers in wave 1. All estimators include school fixed effects and control for own indigenous and Hakka status. Standard errors clustered at the classroom level in parentheses. ***, ** and * mark estimates statistically different from zero at the 99, 95 and 90 percent confidence level.*

Table 2: *Effects of Exposure to Minority Peers on Test Scores of Students*

	(1)	(2)	(3)	(4)
Outcome: Wave 2 test scores				
+1SD in classroom indigenous peers	-0.014	-0.016**	-0.017**	-0.019***
	(0.010)	(0.007)	(0.007)	(0.007)
+1SD in classroom Hakka peers	0.003	0.004	0.003	0.003
	(0.009)	(0.006)	(0.005)	(0.006)
Own test scores in wave 1 [std]		0.734***	0.707***	0.706***
		(0.006)	(0.006)	(0.006)
Indigenous peers × Indigenous				0.005
				(0.004)
Hakka peers × Hakka				0.001
				(0.005)
Indigenous = Hakka (p-value)	0.203	0.013	0.013	0.010
Preassignment controls	No	No	Yes	Yes
R^2	0.22	0.64	0.65	0.65
Schools	307	307	307	307
Classes	1,154	1,154	1,154	1,154
Students	16,262	16,262	16,262	16,262

*Note: This table reports estimates of regressing standardized student test scores in wave 2 on the classroom share of Indigenous and Hakka peers. All regressions include school fixed effects. Pre-assignment controls include all variables tested for balancing in Table 1. Standard errors clustered at the classroom level in parentheses. ***, ** and * mark estimates statistically different from zero at the 99, 95 and 90 percent confidence level.*

Table 3: *Alternative Explanations: Indigenous Students Characteristics*

Outcome of non-indigenous students	(1) **Student test scores in wave 2 [std]**	(2) **Share mediated**
+1SD in classroom indigenous peers	-0.019**	100.0%
	(0.008)	
Effect explained by other peer characteristics	-0.006**	31.6%
	(0.003)	
→ by peer test scores	-0.004**	21.1%
	(0.002)	
→ by peer language skills	-0.002	10.5%
	(0.002)	
→ by peer socioecnomic status	-0.000	0.0%
	(0.001)	
→ by peer parental investments	-0.000	0.0%
	(0.001)	
Students	16,262	

*Note: This table reports mediated effects of Indigenous peers on the majority students test scores based on Gelbach (2016) decomposition. All regressions include school fixed effects and control for the share of Hakka peers, the interaction of Indigenous peers and own Indigenous indicator, and the interaction of Hakka peers and own Hakka indicator. Main effect of Indigenous peers is displayed. These estimates are produced using the b1x2 Stata package on a within-school transformation of the data. Standard errors clustered at the classroom level in parentheses. ***, ** and * mark estimates statistically different from zero at the 99, 95 and 90 percent confidence level.*

Table 4: *Mechanisms: The Role of Students, Parents, and Teachers*

Treatment effect on majority students:	+1SD in classroom Indigenous peers		
	Coef.	Std. err.	Obs.
Student-related mechanisms	-0.014	(0.013)	14,903
Parent-related mechanisms	-0.044***	(0.010)	15,862
Teacher-related mechanisms	-0.083***	(0.025)	14,960
Teacher subjective assessment of student development	0.004	(0.012)	15,193

*Note: This table reports estimates of regressing wave 2 aggregate indexes of student-related (row 1), parent-related (row 2), and teacher-related (row 3) mechanisms as well as teacher's subjective assessment of student's development on the classroom share of Indigenous and Hakka peers, and their respective interactions with own Indigenous and Hakka indicators. Main effects of Indigenous peers are displayed. All regressions school fixed effects and control for indigenous status and test scores in wave 1. Standard errors clustered at the classroom level in parentheses. ***, ** and * mark estimates statistically different from zero at the 99, 95 and 90 percent confidence level.*

Table 5: *The Role of Students, Parents, and Teachers in Explaining the Peer Effect*

Outcome of majority students:	**Student test scores in wave 2 [std]**	**Share mediated**
+1SD in classroom Indigenous peers	-0.019**	100.0%
	(0.008)	
Mediated effect	-0.011***	57.9%
	(0.004)	
→ by student-related mediators	0.006	-31.6%
	(0.005)	
→ by parent-related mediators	-0.005*	26.3%
	(0.003)	
→ by teacher-related mediators	-0.009***	47.4%
	(0.003)	
Students	16,262	

*Note: This table reports mediated effects of Indigenous peers on the majority students test scores based on Gelbach (2016) decomposition. All regressions include school fixed effects and control for the share of Hakka peers, the interaction of Indigenous peers and own Indigenous indicator, and the interaction of Hakka peers and own Hakka indicator. Main effect of Indigenous peers is displayed. These estimates are produced using the b1x2 Stata package on a within-school transformation of the data. Standard errors clustered at the classroom level in parentheses. ***, ** and * mark estimates statistically different from zero at the 99, 95 and 90 percent confidence level.*

Appendix A Additional Tables and Figures

Table A.1: *Construction of Student Behavior Index: PCA Analysis*

(1) Input	(2) Content	(3) First component	(4) Second component
Study hours	Number of hours at school, at tutoring, homework time, …	0.37	0.03
Initiative in class	Ask & answers questions - Math, Chinese, English	0.45	0.11
Truancy	Skipping class, fighting, substance abuse	-0.25	0.42
Cheated on exams	Ever cheats on exams	-0.13	0.53
Academic self-efficacy	Focus, conscientiousness, coopertion, curiosity, …	0.23	-0.26
Mental health	Troubled, depressed, nervous, suicidal thoughts, …	0.00	-0.63
University aspirations	Aspires to go to university	0.51	0.18
University expectations	Expects to be able to go to university	0.52	0.16
Eigenvalue		2.15	1.28

Note: This table reports the results of a principal components analysis of multiple inputs of student behaviors. These inputs were first constructed using numerous survey questions where we compute Spearman correlations between all items under consideration, assess their Cronbach's alphas, and perform a factor analysis generating the variables listed as inputs. The eigenvectors associated with the first and second components are reports, as well as their associated eigenvalues.

Table A.2: *Construction of Parental Behaviors and Investments Index: PCA Analysis*

(1) Input	(2) Content	(3) First component	(4) Second component
Private tutoring	Tutoring hours and expenditures	0.47	0.14
Time with parents	Frequency of various activities together	0.15	0.11
Conflict with parents	Frequency of quarrels with father or mother	0.03	-0.54
Parental strictness	Rule-setting, monitoring money spending, overseeing friends, …	0.49	0.38
Parental support	Discuss future, listens, advise, accepts, …	0.57	-0.27
Harsh parenting	Use of physical punishment	-0.10	0.67
Parent university aspirations	Parents aspire for child to go to university	0.43	-0.09
Eigenvalue		1.50	1.30

Note: This table reports the results of a principal components analysis of multiple inputs of parental behaviors and investments. These inputs were first constructed using numerous survey questions where we compute Spearman correlations between all items under consideration, assess their Cronbach's alphas, and perform a factor analysis generating the variables listed as inputs. The eigenvectors associated with the first and second components are reports, as well as their associated eigenvalues.

Table A.3: *Construction of Teacher Behavior Index: PCA Analysis*

(1) Input	(2) Content	(3) First component	(4) Second component
Teacher engagement	Remembers names, encourages students, cares, adapts, homeworks, reviews	0.09	0.40
Teacher-parent meetings	Number of meetings between parents and teacher	-0.07	-0.40
Teacher mental distress	Felt tired teaching, feels depressed or frustrated, wants to yell, break things, feels tense…	-0.27	0.44
Class hard to manage	N/A	-0.60	0.36
Modern teaching practices	Inputs, exploration, AV aids, outdoor teaching activities…	0.36	0.60
Class level assessed by teacher	How does this class compare to other classes in school?	0.65	0.09
Eigenvalue		1.42	1.09

Note: This table reports the results of a principal components analysis of multiple inputs of teacher behaviors. These inputs were first constructed using numerous survey questions where we compute Spearman correlations between all items under consideration, assess their Cronbach's alphas, and perform a factor analysis generating the variables listed as inputs. The eigenvectors associated with the first and second components are reports, as well as their associated eigenvalues.

Table A.4: *Descriptive Statistics*

	Mean of characteristics in sample:				
	TEPS	Estimation	Indigenous	Hakka	Non-minority
Students:					
Indigenous parent(s)	0.04	0.04	1	0	0
Hakka parent(s)	0.17	0.18	0	1	0
Test scores at baseline [std]	-0.05	0.00	-0.87	-0.02	0.04
Fluent in Mandarin	0.91	0.92	0.88	0.93	0.92
Fluent in indigenous language	0.02	0.02	0.29	0.01	0.01
Fluent in Hakka language	0.04	0.04	0.03	0.15	0.01
Female student	0.50	0.49	0.51	0.48	0.49
Birth year	1989	1989	1989	1989	1989
No. of siblings of student	1.77	1.75	2.36	1.77	1.72
Aspires to go to university	0.45	0.47	0.33	0.47	0.47
Expects to go to university	0.35	0.36	0.25	0.37	0.37
Has conflicts with parents	0.24	0.24	0.26	0.23	0.24
Parents are role models	0.31	0.32	0.36	0.31	0.32
Parents:					
Two-parent household	0.89	0.91	0.84	0.92	0.91
Good relationship between them	3.14	3.15	3.10	3.14	3.15
Parent(s) education is high school or less	0.65	0.65	0.80	0.65	0.64
Employed father	0.89	0.90	0.78	0.90	0.90
Parent(s) in good health	0.59	0.61	0.33	0.62	0.62
Financial difficulties in past 10 yrs	0.27	0.26	0.60	0.23	0.25
Household monthly income is					
NT$20,000 or less	0.11	0.09	0.30	0.09	0.09
NT$20,000-NT$50,000	0.41	0.41	0.47	0.39	0.41
NT$50,000-NT$100,000	0.35	0.35	0.20	0.38	0.36
More than NT$100,000	0.14	0.14	0.03	0.14	0.14
Schools:					
Principal has postgraduate degree	0.29	0.29	0.15	0.24	0.31
Principal years of experience	29.1	29.1	28.1	29.3	29.1
Government founded school	0.86	0.86	0.94	0.85	0.86
School year of foundation	1968	1968	1968	1968	1969
Observations (approx.)	20,055	16,262	588	2,894	12,814

Note: This table presents descriptive statistics for the full TEPS sample (column 1), our main estimation sample (column 2), and separately for Indigenous students (column 3), Hakka students (column 4), and Hoklo and Waishengren ethnic majority students (column 5).

Table A.5: *Heterogeneity: Test Scores*

Outcome:	**Effect on student test scores in wave 2 [std] by:**			
	A. Student gender		**B. Student W1 scores**	
	male	*female*	*below median*	*above median*
+1SD in classroom Indigenous peers	-0.023***	-0.015*	-0.013*	-0.027***
	(0.007)	(0.008)	(0.007)	(0.009)
+1SD in classroom Hakka peers	0.006	0.002	0.003	0.004
	(0.006)	(0.006)	(0.006)	(0.006)
Indigenous = Hakka (p-value)	0.002	0.080	0.052	0.004
Group equality Indigenous (p-value)	0.141		0.040	
Group equality Hakka (p-value)	0.451		0.849	
Outcome mean	-0.05	0.06	-0.65	0.67
Observations in group	8,286	7,976	8,252	8,010
	C. Family income		**D. Predicted parental ability**	
	below NT$ 50k/month	*above NT$ 50k/month*	*below median*	*above median*
+1SD in classroom Indigenous peers	-0.017**	-0.023***	-0.017**	-0.029**
	(0.007)	(0.008)	(0.007)	(0.014)
+1SD in classroom Hakka peers	-0.001	0.006	0.001	0.007
	(0.006)	(0.006)	(0.006)	(0.007)
Indigenous = Hakka (p-value)	0.083	0.004	0.036	0.032
Group equality Indigenous (p-value)	0.348		0.372	
Group equality Hakka (p-value)	0.192		0.413	
Outcome mean	-0.29	0.30	-0.42	0.41
Observations in group	8,197	7,984	7,231	7,503

*Note: This table reports estimates based on specification from column 4 of Table 2, but excluding demographics control variables, run separately by gender (panel A), by student's wave 1 test score (panel B), by family income (panel C), and by predicted parental ability (panel D). Marginal effects of Indigenous and Hakka share of peers are displayed. All regressions include school fixed effects and control for Indigenous status and test scores in wave 1 except for panel B where the baseline test scores are excluded. Three p-values are presented: for the equality of Indigenous and Hakka estimates within group, for equality of Indigenous coefficients across groups, and for equality of Hakka coefficients across groups. Standard errors clustered at the classroom level in parentheses. ***, ** and * mark estimates statistically different from zero at the 99, 95 and 90 percent confidence level.*

Table A.6: *Heterogeneity: Mechanisms*

	Effect of +1 SD in classroom Indigenous peers on:		
	A. Student mechanisms	**B. Parent Mechanisms**	**C. School/Teacher mechanisms**
by student gender (panel I):			
Male	0.005	-0.042***	-0.084***
	(0.014)	(0.011)	(0.025)
Female	0.021	-0.048***	-0.081***
	(0.013)	(0.011)	(0.026)
Difference (p-value)	0.072	0.483	0.636
by student W1 test scores (panel II):			
Below median	0.022*	-0.042***	-0.071***
	(0.013)	(0.011)	(0.025)
Above median	0.002	-0.048***	-0.099***
	(0.015)	(0.011)	(0.027)
Difference (p-value)			
by family income (panel III):			
Below NT$ 50k/month	0.013	-0.047***	-0.075***
	(0.014)	(0.010)	(0.025)
Above NT$ 50k/month	0.014	-0.035***	-0.094***
	(0.013)	(0.013)	(0.026)
Difference (p-value)	0.929	0.219	0.048
by parent predicted ability (panel IV):			
Below median	0.016	-0.052***	-0.073***
	(0.014)	(0.011)	(0.024)
Above median	0.023	-0.037**	-0.106***
	(0.017)	(0.018)	(0.038)
Difference (p-value)	0.718	0.426	0.261

*Note: This table reports estimates based on specification from column 4 of Table 2, but excluding demographics control variables, run separately by gender (panel I), by student's wave 1 test score (panel II), by family income (panel III), and by predicted parental ability (panel IV). The dependent variables, instead of test scores, are student behaviors index (panel A), parental behaviors and investments index (panel B), and teacher/schools behaviors index (panel C). Marginal effects of Indigenous share of peers are displayed but all regressions include also share of Hakka students and the interactions between own minority status and share of students from each minority group. All regressions include school fixed effects and control for wave one values of the specific indexes we consider in each panel. We also present p-values for the equality of Indigenous estimates across groups. Standard errors clustered at the classroom level in parentheses. ***, ** and * mark estimates statistically different from zero at the 99, 95 and 90 percent confidence level.*

Table A.7: *Robustness Checks: Alternative Samples*

Outcome:	**Student test scores in wave 2 [std]**				
			Exclude		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
	Baseline	**Majority Indigenous or Hakka schools**	**Indigenous or Hakka students**	**Private schools**	**Waishengren students**
+1SD in classroom	-0.019***	-0.022***	-0.018**	-0.019***	-0.014*
Indigenous peers	(0.007)	(0.008)	(0.009)	(0.007)	(0.007)
+1SD in classroom Hakka	0.003	0.004	0.009	0.001	0.003
peers	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)
Indigenous = Hakka (p-value)	0.010	0.011	0.013	0.026	0.062
Schools	307	275	306	258	307
Classes	1,154	1,055	1,142	1,021	1,154
Students	16,262	14,760	12,814	14,396	13,395

*Note: This table reports estimates based on Equation 1 where we change how we construct the sample. Column 1 replicates the results from column 4 of Table 2, column 2 excludes schools with majority Indigenous or Hakka students which we define as more than 50% of student population, column 3 excludes Indigenous or Hakka students from the analysis (here we also drop controls for student ethnicity and their interactions with share of the minority students), column 4 drops all private schools where anecdotally there might be more scope for gaming the assignment rules, and finally column 5 drops Waishengren (Mainlanders) from our ethnic majority sample for which we estimate the treatment effects. All regressions include school fixed effects and test scores in wave 1. Standard errors clustered at the classroom level in parentheses. ***, ** and * mark estimates statistically different from zero at the 99, 95 and 90 percent confidence level.*

Table A.8: *Robustness Checks: Definition of Treatment Variables*

Outcome:	**Student test scores in wave 2 [std]**		
	(1)	**(2)**	**(3)**
	+1 SD	**Share (%)**	**Any**
Indigenous classroom peers	-0.019***	-0.400***	-0.048***
	(0.007)	(0.148)	(0.018)
Hakka classroom peers	0.003	0.050	-0.038*
	(0.006)	(0.075)	(0.021)
Indigenous = Hakka (p-value)	0.010	0.004	0.706
Schools	307	307	307
Classes	1,154	1,154	1,154
Students	16,262	16,262	16,262

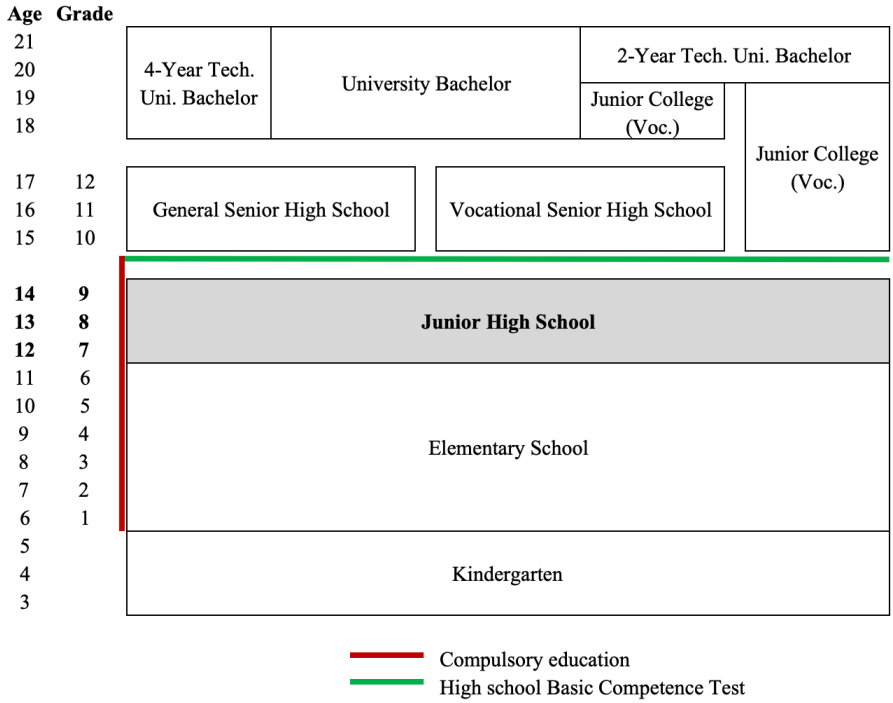
*Note: This table reports estimates based on Equation 1 where we change the definitions of treatment variables. Column 1 replicates the results from column 4 of Table 2, column 2 uses share of peers as a treatment variable (between 0 and 1), while column 3 uses an indicator variable for any minority from a specific group in a classroom. All regressions include school fixed effects and test scores in wave 1. Standard errors clustered at the classroom level in parentheses. ***, ** and * mark estimates statistically different from zero at the 99, 95 and 90 percent confidence level.*

Table A.9: *Mediation Analysis*

Outcome of majority students	**Student test scores in wave 2 [std]**				
+1SD in classroom Indigenous peers	-0.019*** (0.007)	-0.019*** (0.007)	-0.014* (0.008)	-0.008 (0.008)	-0.001 (0.008)
Preassignment controls	No	Yes	Yes	Yes	Yes
Other peer characteristics	No	No	Yes	No	Yes
Mechanisms	No	No	No	Yes	Yes
Fraction explained	N/A	0%	26%	58%	95%
R^2	0.64	0.65	0.65	0.68	0.68
Schools	307	307	307	307	307
Classes	1,154	1,154	1,154	1,154	1,154
Students	16,262	16,262	16,262	16,262	16,262

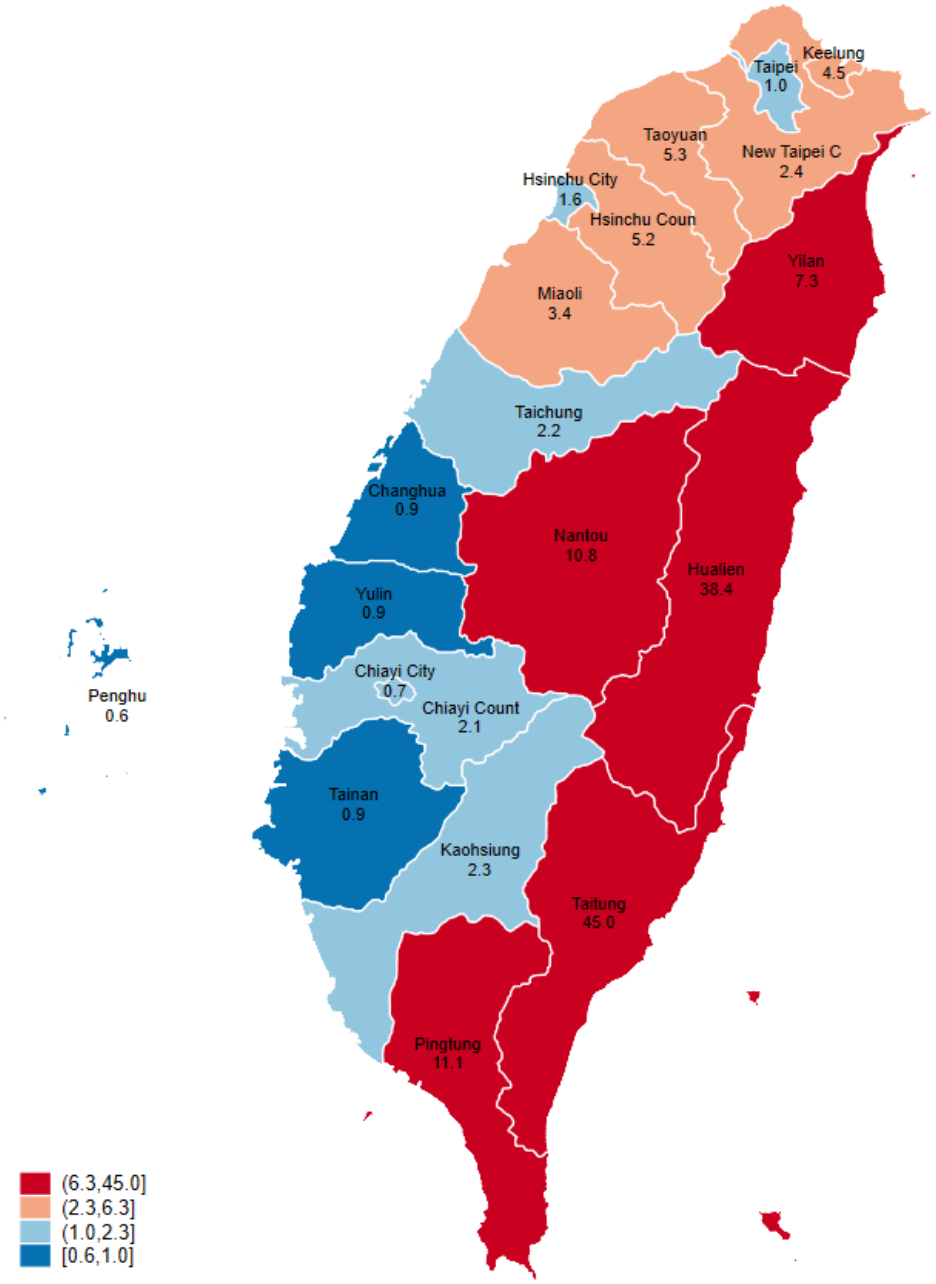
*Note: This table reports estimates of regressing standardized student test scores in wave 2 on the classroom share of Indigenous and Hakka peers, and their respective interactions with own Indigenous and Hakka indicators. Main effects of Indigenous peers are displayed. All regressions include school fixed effects. Pre-assignment controls include all variables tested for balancing in Table 1. Columns 1 and 2 replicate the results from column 4 of Table 2 without and with pre-assignment controls, column 3 then adds correlated peer characteristics that we explored in Section 5.3, column 4 drops the correlated peer characteristics but includes student, parent, and teacher behavioral indexes discussed in Section 5.4, and finally column 5 includes controls from both columns 3 and 4 jointly. Standard errors clustered at the classroom level in parentheses. ***, ** and * mark estimates statistically different from zero at the 99, 95 and 90 percent confidence level.*

Figure A.1: *Schematic of Taiwanese Education System*



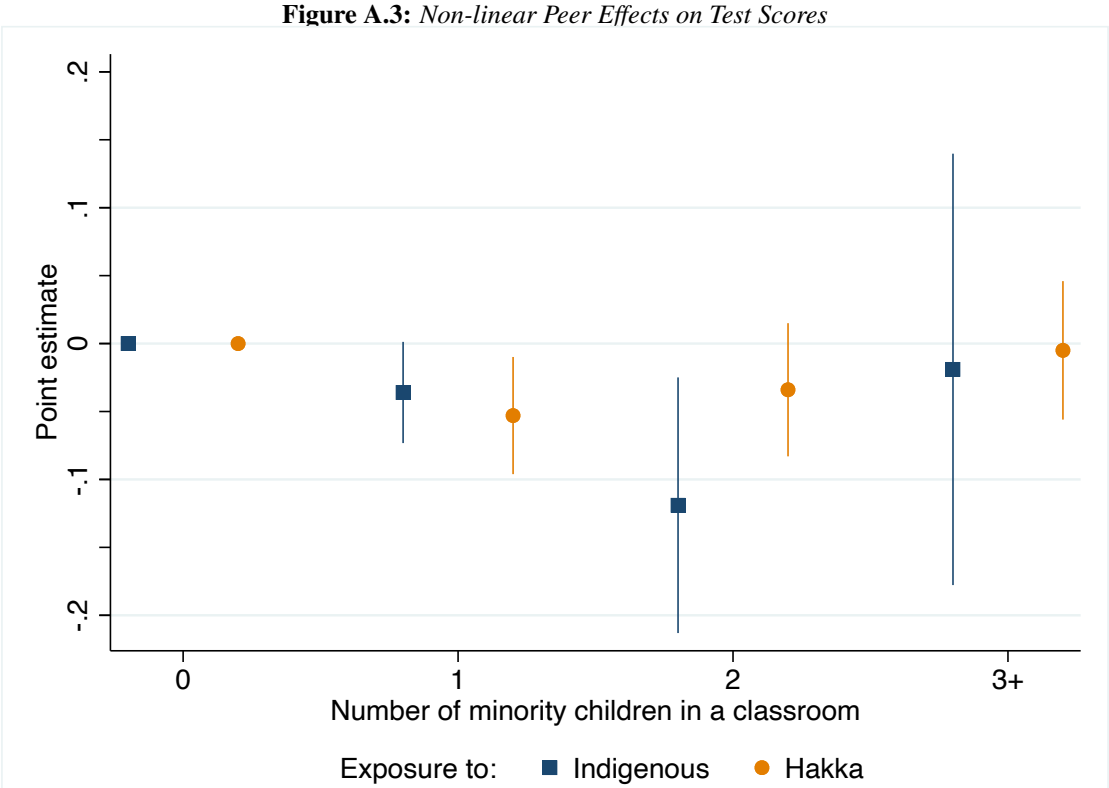
Note: This graph depicts various levels in Taiwanese education system

Figure A.2: *Fraction of Indigenous Children Among 10 to 14 Year Olds by County*



Note: This figure depicts the share of Indigenous children among 10 to 14 year olds in Taiwan by country of residents based on 2010 Taiwanese Census.

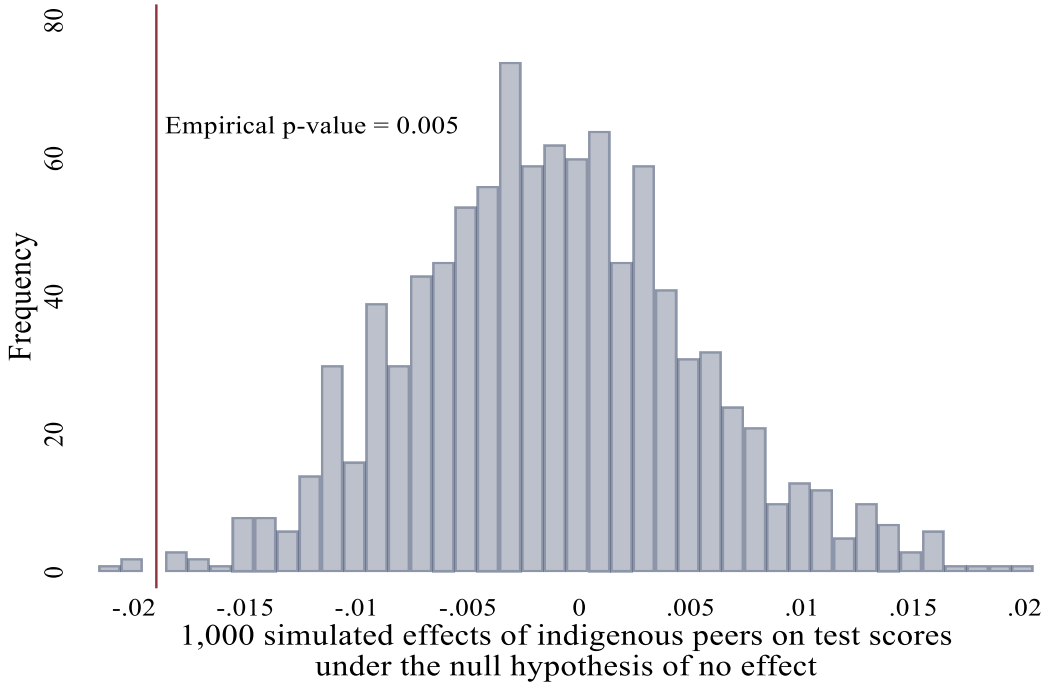
Figure A.3: *Non-linear Peer Effects on Test Scores*



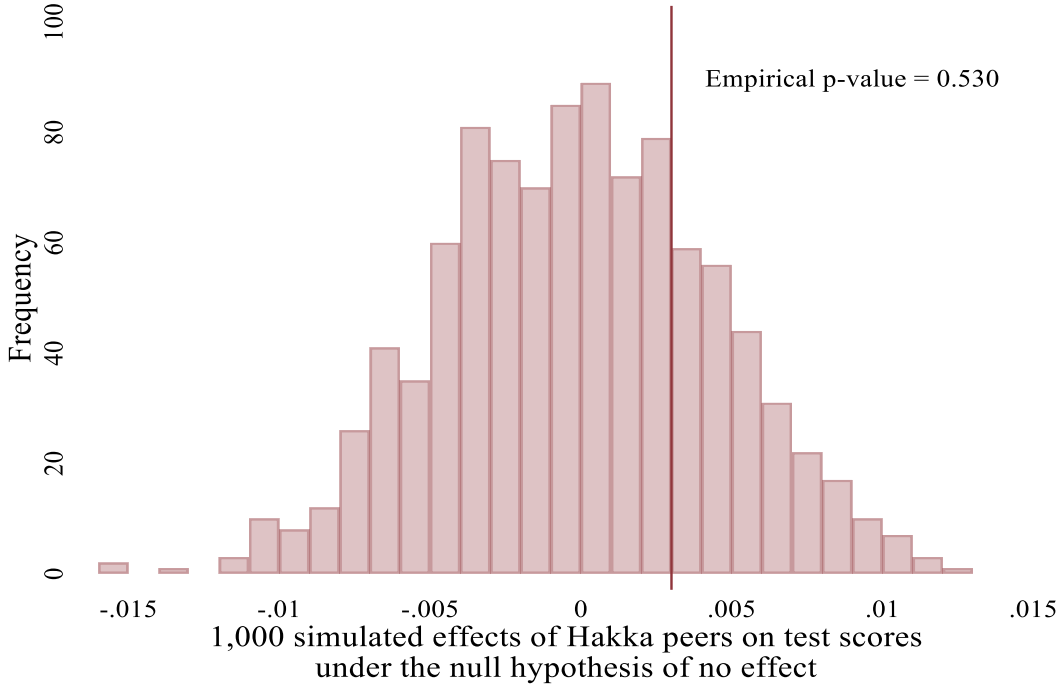
Note: This figure presents estimates based on modified specification from column 4 of Table 2 where we replace the standard deviation in classroom level share of Indigenous and Hakka students with indicators for only one, only two, and three or more Indigenous and Hakka students. Reference group is no minority students in the classroom. Navy squares present estimates for Indigenous peers while orange circles present results for Hakka peers. We also interact these three treatment variables with own minority status. Standard errors clustered at the classroom level and spikes represent 95% confidence intervals.

Figure A.4: *Main Results: Randomization Inference*

(a) *Effects of Indigenous Students*



(b) *Effects of Hakka Students*



Note: These figures present results of a randomization inference computations. Panel A presents results for exposure to Indigenous students while panel B presents results for exposure to Hakka students. The results are based on estimating Equation 1 where the treatment variables – share Indigenous and share Hakka – are based on re-randomized assignment of students to classrooms rather than the true randomized assigned used in main estimation in 2. We re-randomize the class structure 1,000 times. Red vertical lines present our point estimates from the preferred specification in column 4 of Table 2 while the p-values come from computing the location of these point estimates in the simulated distribution.