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PRINCIPAL INTERESTS

Economics of Education, Labor Economics, Development Economics and Machine Learning

ACADEMIC BACKGROUND

Ph.D., Economics 2020-in progress
Massachusetts Institute of Technology, MIT
- Advisors: Prof. Esther Duflo, Prof. Joshua Angrist and Prof. Frank Schilbach

M.A. International Education Policy Analysis 2019-2020
Stanford University
- Thesis: I Want You to Teach My Children: The Effect of Changing the Teacher Hiring Process on Parental School Choice in the Mexican State of Zacatecas.

B.A. Economics 2015-2019
Instituto Tecnológico Autónomo de México, ITAM
- Thesis: The Effect of Universal Scholarships on High School Dropout Rates. Evidence from Mexico.
- Graduated with highest honors

EMPLOYMENT HISTORY

Co-Founder 2021 - Present
Jovenes Ayudando a Ninas y Ninos (Tutoring Program)
- Co-Founded with Bernardo Garcia Bulle Bueno
- Education lab platform to perform education-related RCTs

Research associate 2022 - Present
Blueprint labs
- Under supervision of Prof. Joshua Angrist and Prof. Parag Pathak
- Work: Evaluating the impact of individual teachers on students' academic achievement. We are investigating how these teacher effects compare to the effects of the school environment, utilizing randomization from charter school lotteries to accurately measure the causal effects of schools and teachers.

Research assistant 2019 - 2020
Stanford Center for Education Policy Analysis (CEPA)
- Under supervision of Prof. Eric Bettinger

Research assistant 2017 - 2019
Centro de Investigación Económica (CIE)
- Under supervision of Prof. Enrique Seira

GRANTS AND FELLOWSHIPS

Research grants
- *J-WEL Grant in pK-12 Education Innovation 2022*
- *The Weiss Fund for Research in Development Economics 2022*
- *PPE Initiative Pilot Grant JPAL 2021*
- *Schultz Fund at MIT 2021 and 2022*

Fellowships

- *Emma Krob Castle Graduate Fellow (MIT) 2021-2022*
- *Mexico Fellowship (MIT) 2020-2021*
- *Claudio X. Gonzalez Fellowship (Stanford University)2019-2020*
- *CONACYT/FUNED Scholarship (Stanford University) 2019-2020*

TEACHING (at MIT)

- TA 14.75 Political Economy and Economic Development — Spring 2023
- TA 14.01 Principles of Microeconomics — Fall 2022

RESEARCH PROJECTS

- **Exploring the Impact of a Social and Emotional Learning Intervention on Learning Outcomes and Classroom Dynamics** Joint work with Bernardo García *Working paper*

  Abstract: This paper examines the impact of a social and emotional learning (SEL) intervention on math learning outcomes and classroom dynamics. The study utilizes a tutoring platform and measures a statistically significant increase in math learning of 0.1 standard deviations following the SEL intervention. The paper also finds that the classroom dynamics change after the intervention, with SEL students asking more questions and having more positive emotional interactions with the teacher. This study highlights the importance of emotional intelligence and the potential for SEL interventions to improve both academic and social outcomes for students.

- **Can Single Gender Classrooms Counteract Traditional Gender Beliefs? Evidence From a Tutoring RCT.** Joint work with Bernardo García *Working paper*
- **Good Vibes in Class: A Tool to Detect Which Emotions Lead to More Learning** Joint work with Fernanda Albo, Bernardo García and Tobin South, *Working paper*

  We present a method to characterize the classroom environment through emotion detection from audio recordings. Using machine learning tools we build an emotion classifier using MFCC features of labeled voice clips and apply it to slices of more than 1,500 online class session records. We find that higher measurements of high-intensity emotions were significantly correlated with higher Teacher Value Added (TVA) estimates, determined using Math test scores of students before and after receiving tutoring. Secondly, we found that attendance metrics in the second class were highly correlated to the class environment in the first class. Finally, we found that higher-skilled tutors progressively increased high-intensity emotions as they had more sessions with their students.

- **I Want You to Teach My Children: The Effect of Changing the Teacher Hiring Process on School Choice in the Mexican State of Zacatecas.** MA Thesis *2020 (Stanford University)*,
- **The Effect of Universal Scholarships on High School Dropout Rates. Evidence from Mexico.** BA Thesis *2019 (ITAM)*,

Research Proposal

My research at MIT, advised by Prof. Esther Duflo and Prof. Frank Schilbach, has two distinct focus areas. The first is on education program design: with the aid of remote learning technology, can we deliver high-quality teaching at scale in developing-country contexts? The second is on unpacking the `black box' of classroom dynamics: what classroom environments are best at increasing mathematics knowledge? Do factors complementary to math content, such as student social and emotional capacity, quantitatively increase test scores? And how do students and teachers behave differently in high- and low-quality classrooms?

To answer these questions, I run RCTs and collect data from *Jovenes Ayudando a Ninas y Ninos* (JANN), a new large-scale free online math tutoring platform in Mexico. I founded JANN as a first-year PhD student in January 2021 alongside Bernardo Garcia, an IDSS Ph.D. candidate at MIT. Our initial goal was to provide remote education to Mexican grade school students during the COVID-19 crisis. As of April 2023, 18,260 students have received twice-weekly classes from 4,641 tutors through the program.

JANN works as follows. In Mexico, university students must fulfill a 480-hour social service requirement to graduate; we have partnered with private and public universities to recruit, train and interview university students to act as tutors for children in all grades between the 3rd grade of primary school to the 1st year of high school. Tutors are then assigned to groups of 5 students in grades 5-10 located across Mexico who meet for 2 hours a week on Google Meet for 12-20 consecutive weeks. At least one weekly class is mathematics, and we evaluate learning progress via tests at baseline and endline.

JANN has multiple features ideal for research. Most directly, since we choose teacher assignment and course content, we can run RCTs to evaluate these decisions. In addition, we have audio recordings of <u>all</u> JANN classes, and therefore see 'inside the classroom' at the scale necessary for statistical analysis. These data are entirely novel: classroom observation by an expert is usually prohibitively expensive and subject to monitor bias. In our context, we can estimate treatment effects on *classroom practices and student responses to them* – for instance, speaking time by students and teachers, whether students sound happy or sad, and whether teachers lecture vs. teach interactively – and therefore can identify characteristics of successful math classrooms that can be extrapolated to other contexts.

Below I describe our two ongoing projects. Both align with the fellowship's goal of "mathematical talent development." However, now that program logistics are largely stable and established, I am excited by the opportunity to seek out more collaborators and new ideas for "talent identification" in our context over the next year.

A. Preparing to learn: the effect of improving social and emotional skills on math scores (n=9000, complete)

Intervention: We analyze the impact of accompanying our math tutoring with social and emotional learning (SEL), using a methodology called RULER (Brackett 2012) in which students are guided through activities aimed at teaching them how to identify, name and process different emotions SEL aims to develop general non-cognitive skills such as self-control, awareness, and interpersonal skills; we hypothesize that improving such skills improve math scores by helping students to manage stress and persist when facing challenges. In an RCT, we randomize 1800 groups into either receiving 10 sessions of SEL or a control condition that receives 10 sessions of Mexican history, both in addition to their math classes.

Findings thus far: The SEL intervention has an ATE of 0.1 SD (se: 0.032) on math scores. This effect was driven by students in the top quartile of baseline math scores (effect of 0.14 SD (se: 0.06)), suggesting SEL interventions may be critical for further development of the most talented children. In a preliminary analysis of math class recordings, we observe divergence in classroom dynamics over time: students in the SEL condition asked more questions, had more exchanges with the tutor, and used more math-related words. Using a machine learning emotion predictor trained by us using publicly available labeled datasets linking audios to emotion, we find that math classes in the SEL treatment arm were characterized with more positive emotions.

Next steps: using (data-intensive) ML voice recognition, obtain measures of behavior (participation, emotions, etc.) for each tutor and student. This lets us decompose the treatment's effect on tutor versus student behavior, and additionally leverage timing of specific modules to understand which components of SEL have the largest effects on students with different initial performance levels.

B. Mitigating traditional gender beliefs via classroom composition (n=8000, ongoing)

Intervention: We test if and why single-gender classrooms improve learning outcomes for girls (Carlana 2019; Alan 2018). We focus on one hypothesis: in countries such as Mexico where conservative or `traditional' gender beliefs (TGB) are prevalent, TGB-holding teachers in mixed-gender classrooms may discourage or provide less attention to female students, generating a gender gap in learning outcomes. To test this hypothesis, we cross-randomize students to either single- or mixed-gender classrooms, and to more- vs. less-traditional teachers as measured as baseline.

Findings thus far (pilot with n=1045): Among groups with a TGB-holding teacher, all-female (vs. mixed) groups improve learning outcomes for girls by 0.206 SD (SE: 0.104). Classroom composition has no effect on girls with non-TGB teachers and no effect on boys. The pilot findings suggest single-gender classrooms may be particularly important for improving math talent in more traditional countries or fields of study.

Next steps: report results from full study in fall 2023; clean and analyze classroom recordings to document mechanisms by which single-gender classrooms improve outcomes (ex: changing student mood vs. teacher feedback).

C: Unpacking teacher value-added (planned for 2024): Using the random teacher assignment in JANN we plan to estimate teacher value-added (TVA) (Chetty, Friedman & Rockoff, 2011), by 2024 we expect to have a large enough sample size to identify correlates of TVA with features extracted from the class recordings. Our sample so far is over ~100,000 hours of class recordings; in contrast, typical class observation studies have sample sizes below 100.

References

Esther Duflo: eduflo@mit.edu

Frank Schilbach: fschilb@mit.edu

Overview: I am a third-year PhD student in the MIT economics department focusing on the economics of education. My research aims to unpack the `black box' of math education in collaboration with *Jóvenes Ayudando a Niñas y Niños* (JANN), an biweekly virtual tutoring program for 12,000 Mexican grade-school students which I founded in January 2021. We have two in-progress experiments: i) varying classroom gender composition when teachers have traditional gender beliefs, and ii) teaching social and emotional skills to students alongside mathematics. At MIT I also worked for Parag Pathak and Josh Angrist on a project comparing the causal effects of teachers and of charter schools.

Before MIT, I gained exposure to economics of education research using a range of methods. I completed a BA in economics from ITAM, during which I worked with Prof. Enrique Seira on a project on spatial differences in school quality, leveraging administrative data from the Mexican national exam (ENLACE); and evaluated a Mexico City scholarship program's effects on dropout rates using a DID design for my senior thesis. I also pursued a master's degree from the Stanford School of Education prior to attending MIT. I analyzed RCT data on growth mindsets and college savings as an RA to Prof. Eric Bettinger. Finally, advised by Prof. Caroline Hoxby and Prof. Bettinger, for my thesis I estimated a school choice model with heterogeneous teacher quality using Mexican administrative data.

RA and pre-PhD independent work: I have been consistently interested in education in developing countries, with a focus on constraints to education access in Mexico, since my early undergraduate exposure to economics.

I completed my Bachelor's degree in Economics at ITAM in Mexico. During my undergraduate studies, I worked as a Research Assistant for two years under the supervision of Prof. Enrique Seira. I primarily helped him kickstart a project using newly acquired administrative data from the Mexican government on scores from the national exam (ENLACE). We worked closely with the World Bank and the Mexican Central Bank and linked the academic performance of middle school students to long-term outcomes such as criminality, civic involvement, and formal employment. We also attempted to measure differences in school quality between private and public schools in Mexico. For instance, we wanted to understand the high discrepancy in student outcomes among some schools in close geographical proximity, which raised questions about the completeness of parents' information about the quality of nearby schools.

My BA thesis presented a difference-in-difference model to identify the causal effect of a universal scholarship implemented in Mexico City on high school dropout rates. Anyone enrolled in a public high school in Mexico City was eligible to apply for the scholarship. While the policy had no impact on earlier high school grades, there was a decrease in the dropout rate of students in the last year of their studies, and the average age in the treated schools increased, suggesting that the scholarship was helping retain students who were older and closer to graduation.

Pursuing my interest in education, in 2019, I enrolled in a master's degree in International Education Policy Analysis at Stanford. During my master's degree, I worked as an RA under the supervision of Professor Eric Bettinger, where I worked on the early stages of an RCT on growth mindset. I also performed data analysis of an RCT on college savings. My MA thesis was advised by Professor Caroline Hoxby and Professor Eric Bettinger and focused on the effects of teacher quality on school choice. I estimated a model of school choice (Berry, Jacob & Levitt 1994) using data from a nationwide standardized test in Mexico. I found no evidence that the chance of parents choosing a school changed if the percentage of teachers hired through the merit-based system increased.

These early research experiences prompted me to pursue rigorous quantitative research via a Ph.D. in Economics. In 2020 I started at MIT. At MIT, I have RAed in Blueprint Labs under the supervision of Professor Parag Pathak and Professor Josh Angrist in a project evaluating the impact of individual teachers on students' academic achievement. We are investigating how these teacher effects compare to the impact of the school environment, utilizing randomization from charter school lotteries to measure the causal effects of schools and teachers accurately.

Current work: During my first year in the Ph.D. in January of 2021, together with Bernardo García (an MIT, Ph.D. candidate at IDSS), co-founded "Jóvenes Ayudando a Niñas y Niños" (JANN), a free online math tutoring program. Bernardo and I set up the platform intending to deploy a tutoring RCT. Today, the platform is thriving, impacting more than 18,260 unique students since founding, and has allowed us to run two different RCTs. The platform has the potential to enable us to test further hypotheses regarding the determinants of math learning outcomes, as I explain in my research proposal.

Value of fellowship: Over the next year, the key constraint on using JANN for additional experiments on math education are my time and the ability to supervise implementation. The stipend and tuition assistance would provide me the time to analyze results and turn them into papers; and the research support fund would enable me to efficiently travel back-and-forth to Mexico as needed to meet with schools, my surveyors, and state education departments as needed throughout the academic year.