Learning About Oneself

The Effects of Signaling Academic Ability on School Choice

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Motivation

- Forward-looking investments in human capital are made under uncertainty.
- Recent and growing literature on informational interventions
  - School characteristics (Hastings-Weinstein, 2008; Mizala-Urquiola, 2014)
  - Labor market returns (Jensen, 2010; Wiswall-Zafar, 2015)
  - Application procedures, and financial aid opportunities (Hoxby-Turner, 2014; Dinkelman-Martinez, 2014)
- Less is known about the role of *perceived* individual traits.
  - Biased self-perceptions about academic ability may distort payoffs of schooling careers
    - Skill mismatch

This Paper

- How do individual self-perceptions affect schooling decisions?
  - To what extent information provision better aligns individual skills and schooling careers?
  - How do beliefs shape curricular choices?
- We overlay a field experiment in a school assignment mechanism
  - Elicit subjective belief distributions about performance in an achievement test
  - Administer an achievement test
  - Provide feedback about performance in the test
  - Track impacts on beliefs, school choices and later academic outcomes

Outline of the Talk

1. Context and experimental design
2. Model
3. Main Results
   (a) Belief updating
   (b) Track choices, admission, and high school outcomes
4. Mechanisms
   (a) Interplay of mean and variance of the belief distribution
5. Conclusions

Context

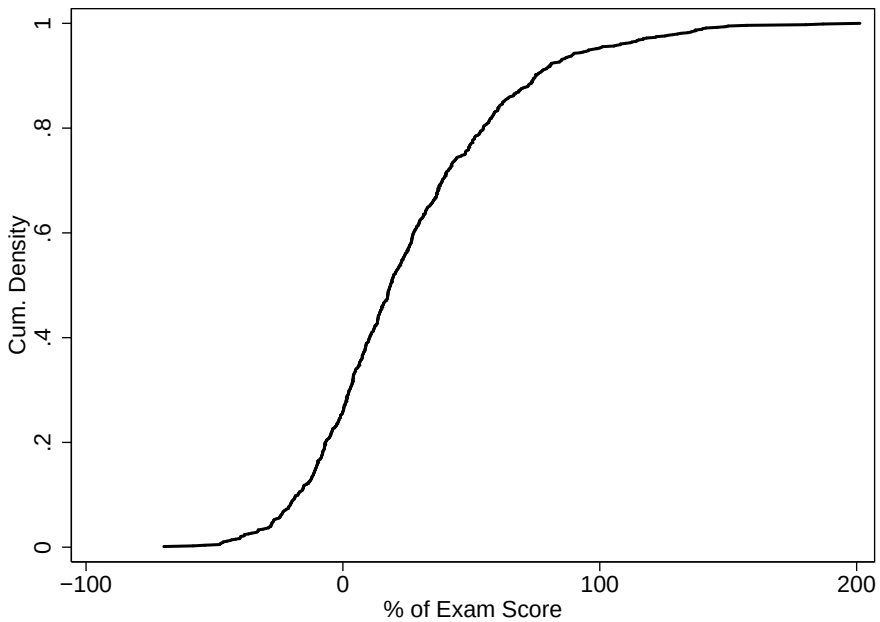
- Centralized admission system into public high schools in Mexico City (COMIPEMS)
  - Assignment based on submitted school rankings and scores in exam
  - Students submit school portfolios **before** taking the exam
- High school tracks: General, Technical, and Vocational
  - General (academic) track students are more likely to go to college
  - Technical or vocational students more likely to be working after secondary

Context (cont'd)

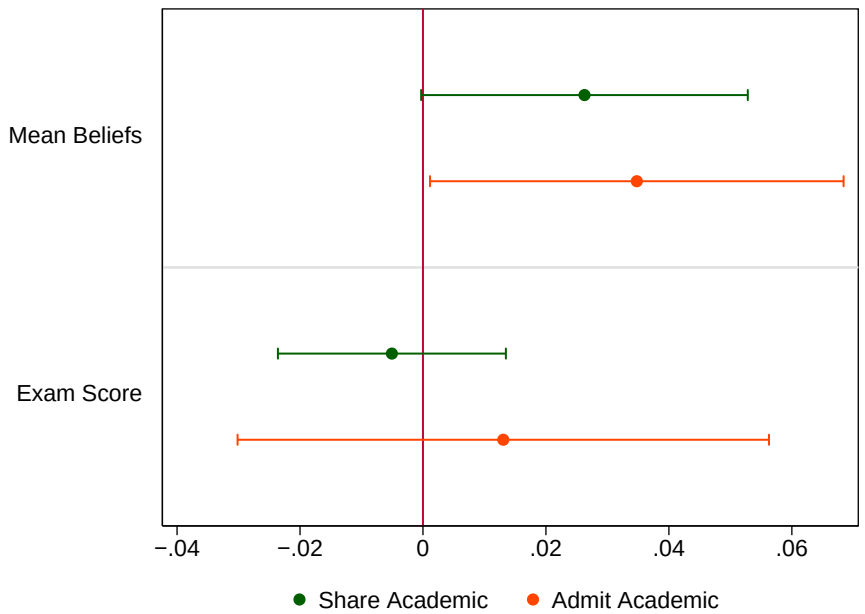
- Timing of the application process may be prone to skill mismatch

Figure : Motivational Evidence

(a) Gap between Expected and Actual Exam Score



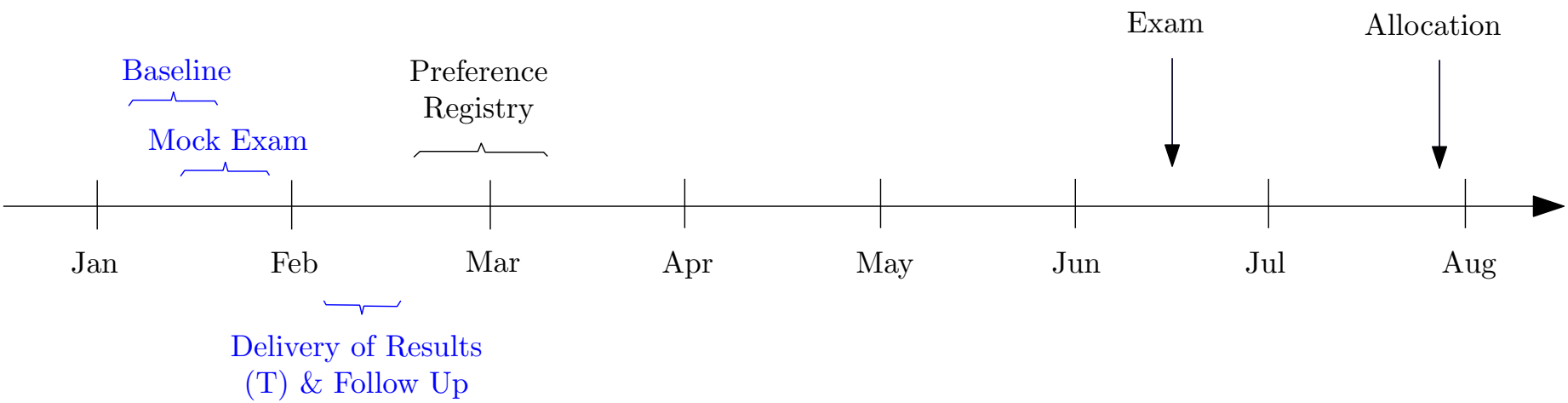
(b) Track Choice and Placement



Field Experiment

1. Administer a mock version of the admission exam
   - Schools in poor urban-suburban city blocks
   - Mock scores predict GPA in high school, but only in academic track Evidence
2. Random assignment at the school level
   - 46 placebo (only mock), 44 (mock+feedback) treatment and 28 control schools Score Delivery Sheet Balance Table
3. Elicit distribution of perceived academic ability both before and after treatment
   - Visual aids to elicit expectations about test performance Measurement
4. Link with administrative data on application portfolios, admission and high-school outcomes

Timeline


Exam
Allocation
Baseline
Mock Exam
Preference
Registry
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Delivery of Results
(T) & Follow Up

Descriptives

- Application portfolios
  - Median size is 10 schools, and less than 10% of applicants request under 5 options
  - Track composition: 51% academic, 37% technical and 12% vocational
- School assignment and outcomes
  - 8% not assigned, two thirds assigned in their top 4 choices, 85% assigned in same state
  - 63% enroll in assigned high school
  - 17% do not pass the first year

Bayesian Learning

- Students have ability priors $q_i \sim N(\mu_i, \sigma_i^2)$
- They receive noisy signals $s_i = q_i + \epsilon_i$, where $\epsilon_i \sim N(0, \sigma_\epsilon^2)$, and update

$$\begin{aligned} \mu_i^{'} &= E(q_i|s_i) = \mu_i + (s_i - \mu_i)\frac{\sigma_i^2}{(\sigma_i^2 + \sigma_\epsilon^2)} \\ \sigma_i^{2'} &= Var(q_i|s_i) = \left[1 - \frac{\sigma_i^2}{(\sigma_i^2 + \sigma_\epsilon^2)}\right]\sigma_i^2 \end{aligned}$$

- Sign of $(s_i - \mu_i)$ determines direction of the update
- Notice that even a signal as noisy as the priors halves the variance

Curricular Choices

- Expected utility from attending track j:

$$U_{ij} = Pr(q_i > q_j^\star) \times V_{ij}$$

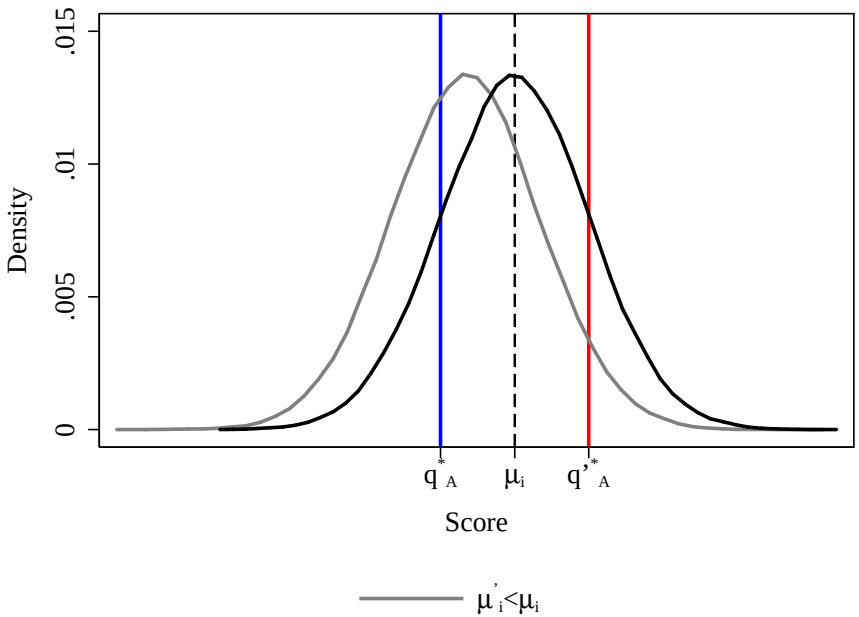
where $q_A^\star > q_{NA}^\star = 0$.

- Changes in expected ability affect track choices:

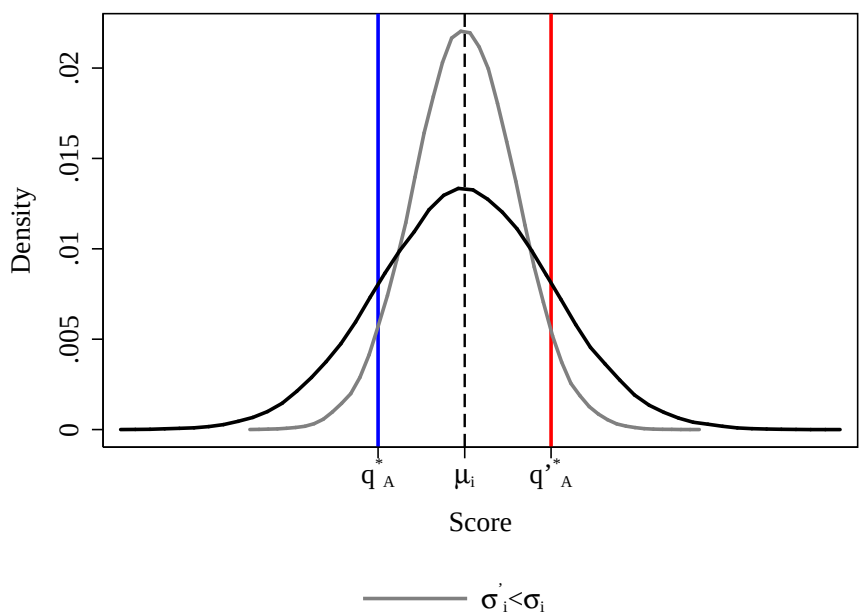
$$\begin{aligned}
\frac{\partial U_{iA}}{\partial \mu_i} &= \frac{1}{\sigma_i}\phi\left(\frac{q_A^\star - \mu_i}{\sigma_i}\right) V_{iA} + \left[1 - \Phi\left(\frac{q_A^\star - \mu_i}{\sigma_i}\right)\right] \frac{\partial V_{iA}}{\partial \mu_i} \geq 0, \\
\frac{\partial U_{iA}}{\partial \sigma_i} &= \phi\left(\frac{q_A^\star - \mu_i}{\sigma_i}\right)\left(\frac{q_A^\star - \mu_i}{(\sigma_i)^2}\right) V_{iA} \geq 0 \quad \text{if } (q_A^\star - \mu_i) \geq 0 \\
\frac{\partial U_{iNA}}{\partial \mu_i} &= \frac{\partial U_{iNA}}{\partial \sigma_i} = 0.
\end{aligned}$$

The Role of the Ability Distribution on the Likelihood of Success

(c) Mean Changes



(d) Variance Changes



- Changes in mean beliefs are monotonic on choices
- Increased precision in ability distribution can either enhance or dilute changes in mean beliefs

Treatment Effects on Beliefs' Distribution

Sample	Placebo & Control		Treatment & Placebo		
Dep. Var.	Mean	SD	Mean	SD	Abs.Gap
	(1)	(2)	(3)	(4)	(5)
Exam Taking	1.483	0.905			
	(1.281)	(0.626)			
Score Delivery			-7.525***	-2.626***	-6.596***
			(0.945)	(0.420)	(0.642)
Mean Dep. Var.	75.61	17.45	75.61	17.45	19.59
N. Obs	1999	1999	2293	2293	2293
R-squared	0.129	0.041	0.287	0.083	0.290
No. of Clusters	74	74	90	90	90

OLS estimates. School clustered standard errors in parentheses.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Summary of Evidence on Belief Updating Patterns

- Score delivery reduces gap by 1/3 and SD by 17%.
  - No effect of exam taking on posteriors
- Treatment effects are broadly consistent with Bayesian updating Table
  1. Treatment reduces dependence of posteriors on priors
  2. Average treatment effect on mean beliefs dominated by downward-updaters who have relatively more biased priors

Track Choices, Admission, and High School Outcomes

Sample	Treatment & Placebo			
Dependent Variable	Share Academic	Admission Academic	High School Drop-out	High School GPA
	(1)	(2)	(3)	(4)
Treatment× Mock Exam Score	0.041***	0.059**	-0.012	-0.049
	(0.013)	(0.027)	(0.021)	(0.072)
Treatment	0.012	-0.026	0.025	-0.037
	(0.016)	(0.026)	(0.024)	(0.069)
Mock Exam Score (z-score)	-0.016*	0.004	-0.034*	0.336***
	(0.009)	(0.022)	(0.018)	(0.049)
Mean Dependent Variable	0.518	0.477	0.148	7.662
Number of Observations	2293	2045	1529	1302
R-squared	0.087	0.067	0.380	0.440
Number of Clusters	90	90	90	90

OLS estimates, high school FE included in Column 4. School clustered standard errors in parentheses.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Summary of Evidence on Schooling Outcomes

- Treatment better aligns preferences for (and assignment in) the academic track with realized academic performance
  - Average effect size of one schooling option in the portfolio
  - No effect of the treatment on other portfolio outcomes Other Treatment Impacts
- No effects on dropout or on learning outcomes (at least in the short run)

The Role of Beliefs on Track Choices

- We use two sources of variation in the data
  - Treatment-induced changes in belief distributions
  - Cross-state variations in academic requirements
    - Variance reductions in markets with low admission and graduation standards reinforce positive effect of upward updates in mean beliefs.
- Two empirical approaches
  - Heterogenous treatment effects based on beliefs' updating patterns
  - Bayesian posteriors as instruments for actual posteriors

Heterogeneous Treatment Effects on Track Choice

Dependent Variable	Share of Academic Schools		
Sample	All	Upward-updaters	Downward-updaters
Treat×(Upward-updater)	0.083***		
	(0.029)		
Treat×(Downward-updater)	-0.005		
	(0.017)		
Upward-updater	-0.057**		
	(0.022)		
Treatment		0.120***	0.019
		(0.033)	(0.020)
Treat×(Federal District)		-0.118*	-0.084***
		(0.061)	(0.030)
Federal District		0.149**	-0.050
		(0.068)	(0.031)
Mean Dependent Variable	0.51	0.46	0.52
Number of Observations	2293	441	1852
R-squared	0.086	0.171	0.092
Number of Clusters	90	84	90

School clustered standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

The Effects of Beliefs on Track Choices: IV Approach

Sample	Treatment & Placebo		
Dependent Variable	Posterior Mean	Posterior SD	Share Academic (2SLS)
Bayesian Mean Posterior	0.648***	-0.027	-0.001
	(0.052)	(0.020)	(0.001)
Bayesian SD Posterior ×DF	0.572***	1.191***	0.001
	(0.157)	(0.105)	(0.002)
Bayesian SD Posterior ×MEX	0.392***	1.266***	0.001
	(0.131)	(0.085)	(0.002)
Treatment			0.076
			(0.054)
Treat×Mean Posterior			0.047**
			(0.024)
Treat×SD Posterior×DF			-0.008***
			(0.003)
Treat×SD Posterior×MEX			-0.002
			(0.003)
Mean Dep. Var.	72.45	16.61	0.518
Number of Observations	2171	2171	2171
R-squared	0.337	0.281	0.085
Number of Clusters	90	90	90

Summary of Evidence on the Role of Beliefs on Track Choice

- Both mean and variance of belief distribution matter
  - The share of academic options moves in the same direction in which the treatment shifts the posteriors
  - Variance reductions lead to a decrease in the share of academic options in settings with stricter admission and graduation standards
- Implications for interpreting treatment effects from policy changes
  - Improved precision of beliefs may partly confound mean changes
  - Evidence on other schooling responses is consistent with this mechanism

Admission Exam

Conclusions

- Information provision on individuals' academic skills impacts curricular choices and later trajectories
  - Imprecise self-views about academic skills may contribute to skill mismatch
- Both mean and variance of belief distribution shape school choices
  - Noisiness in beliefs reinforces or undoes mean effects of signals
  - Key role of beliefs' measurement in evaluating information interventions

Thank you

Changes in Expectation Gaps By Baseline Values

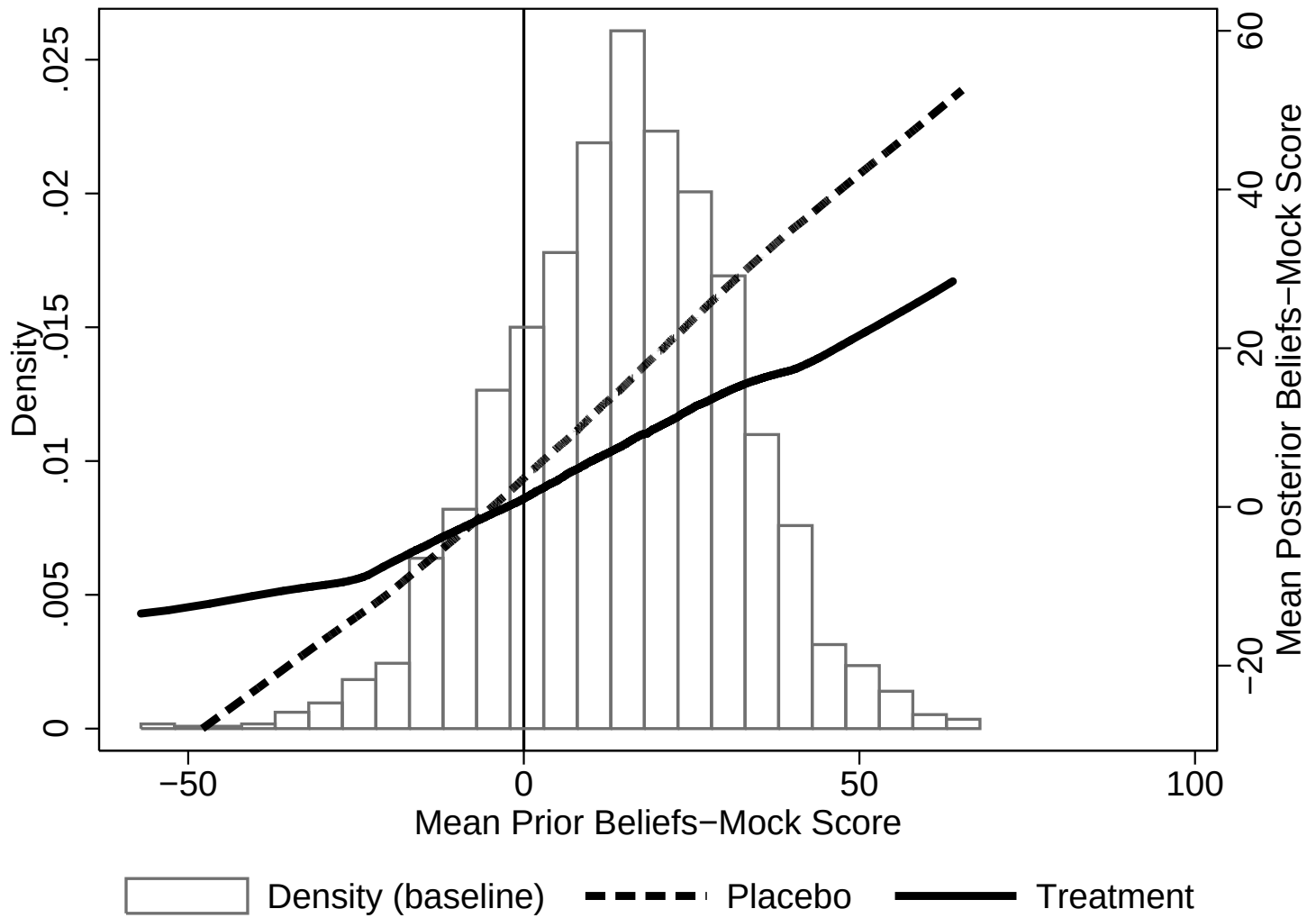
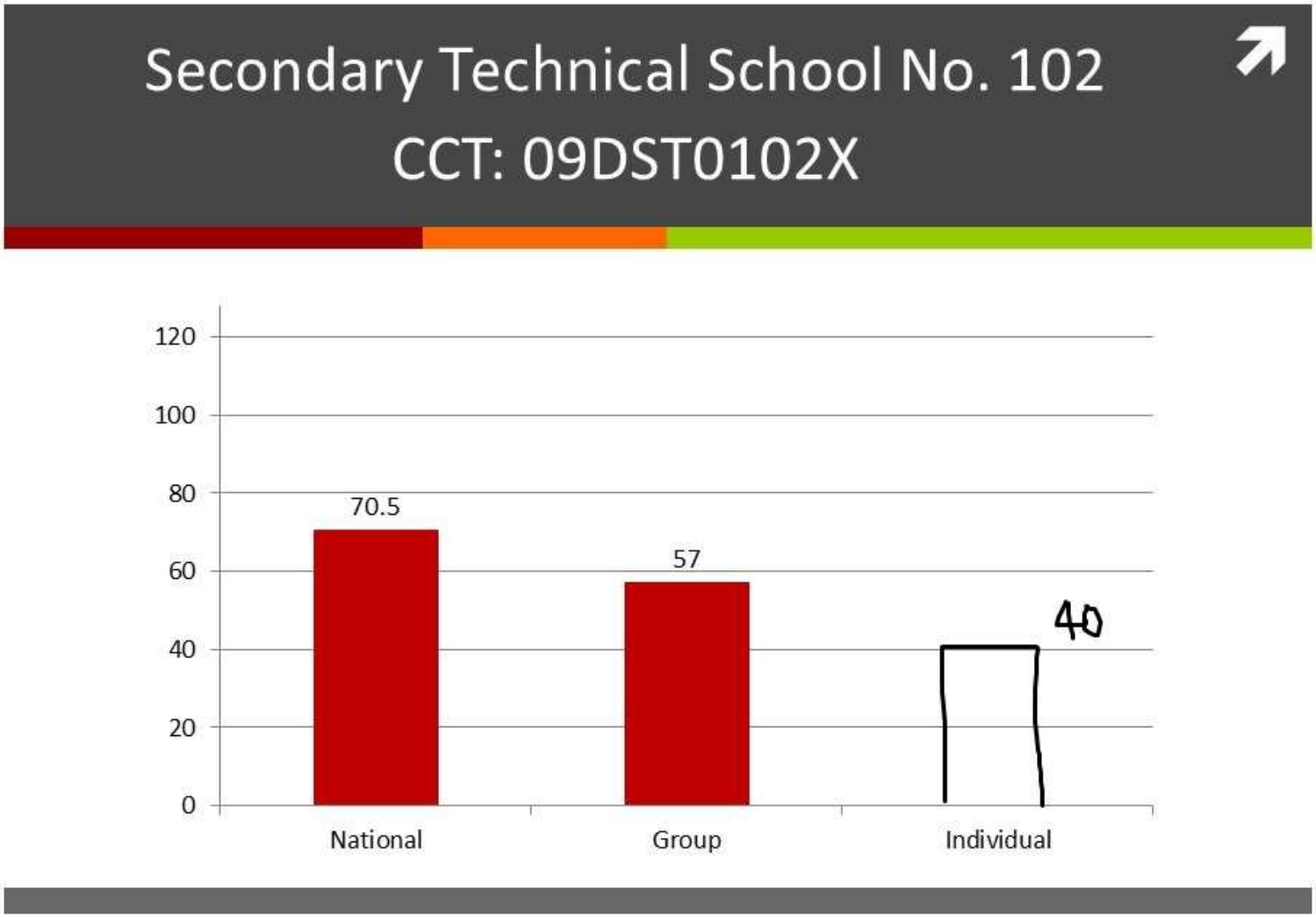


Figure : Sample of the Performance Delivery Sheet back



Measurement of Beliefs

- Link the number of beans placed in a container to a probability measure and ask:

Suppose that you take the COMIPEMS exam today, in which the maximum possible score is 128 and the minimum is zero. How sure are you that your score is...

Between 0 and 40	
Between 40 and 55	
Between 55 and 70	
Between 70 and 85	
Between 85 and 100	
Between 100 and 128	

back to main slide

Table : Balance Check

	Placebo (P)	Treated (T)	Control (C)	T-P	P-C	T-C
Mean prior beliefs	74.39	74.45		0.015		
	(14.42)	(14.40)		[0.98]		
SD prior beliefs	18.06	17.62		-0.526		
	(8.29)	(8.33)		[0.25]		
Mock Exam score	58.77	60.75		1.654		
	(15.62)	(16.40)		[0.13]		
GPA (middle school)	8.094	8.126	8.049	0.011	0.059	0.065
	(0.87)	(0.84)	(0.85)	[0.83]	[0.34]	[0.31]
COMIPEMS enrollment	0.904	0.898	0.885	-0.007	0.027	0.019
	(0.29)	(0.30)	(0.32)	[0.58]	[0.13]	[0.23]
COMIPEMS pre-enrollment	0.484	0.514	0.563	0.008	-0.106	-0.099
	(0.50)	(0.50)	(0.49)	[0.89]	[0.16]	[0.20]
Gender (male)	0.469	0.497	0.478	0.024	-0.001	0.022
	(0.50)	(0.50)	(0.50)	[0.17]	[0.95]	[0.24]
Lives w/ both parents	0.784	0.795	0.749	0.010	0.042	0.050
	(0.41)	(0.40)	(0.43)	[0.60]	[0.08]	[0.04]
Parents with higher ed.	0.122	0.126	0.112	0.007	-0.021	-0.016
	(0.33)	(0.33)	(0.32)	[0.71]	[0.33]	[0.52]

Table : Balance Check (Con'td)

back

	Placebo (P)	Treated (T)	Control (C)	T-P	P-C	T-C
SE index (above-median)	0.491	0.527	0.476	0.025	-0.001	0.022
	(0.50)	(0.50)	(0.50)	[0.32]	[0.96]	[0.47]
Currently working (w/o wage)	0.324	0.306	0.382	-0.021	-0.044	-0.065
	(0.47)	(0.46)	(0.49)	[0.33]	[0.13]	[0.022]
Previous mock-test (dummy)	0.287	0.305	0.269	0.017	-0.001	0.018
	(0.45)	(0.46)	(0.44)	[0.64]	[0.98]	[0.72]
Previous mock-exam w/ results	0.179	0.193	0.151	0.012	0.010	0.023
	(0.38)	(0.39)	(0.36)	[0.73]	[0.79]	[0.59]
Attend prep. course	0.519	0.497	0.419	-0.027	0.067	0.045
	(0.50)	(0.50)	(0.49)	[0.37]	[0.08]	[0.25]
Morning shift (junior high-school)	0.618	0.664	0.779	0.007	-0.118	-0.110
	(0.49)	(0.47)	(0.41)	[0.94]	[0.28]	[0.31]
Plans to attend college	0.729	0.718	0.689	-0.014	0.013	-0.002
	(0.45)	(0.45)	(0.46)	[0.50]	[0.66]	[0.94]
Missing value (any control variable)	0.344	0.369	0.323	0.028	-0.018	0.008
	(0.48)	(0.48)	(0.47)	[0.22]	[0.55]	[0.79]

Figure : Predictors of High-School GPA (1st year) back

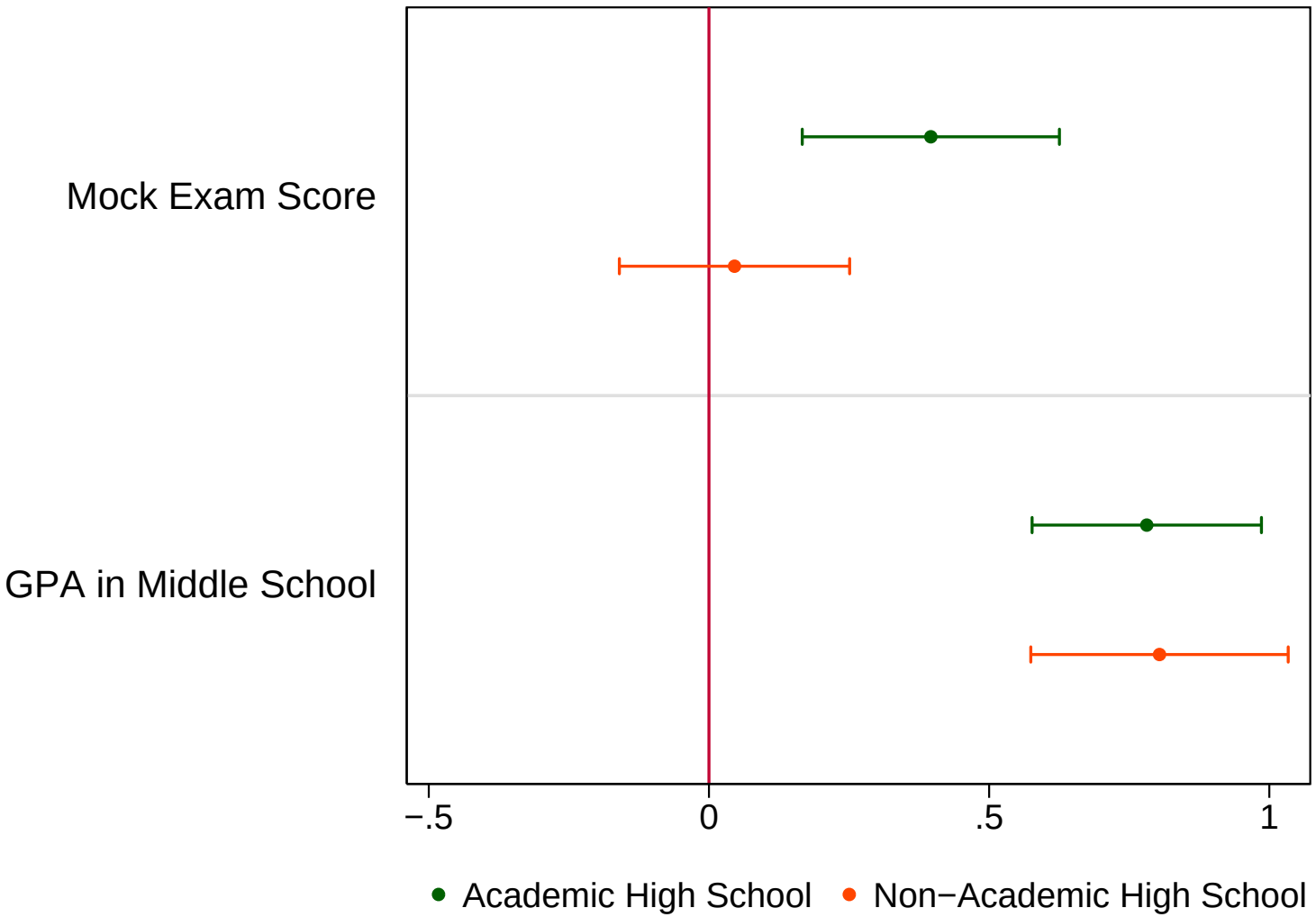


Table : Other Treatment Impacts

back

Sample	Treatment & Placebo				
Dependent Variable	Number of Options	Average Cutoff	Share UNAM	Share UNAM-IPN	Share in Own Municipality
TreatXMock Exam Score	-0.146	1.158	0.019**	0.016	-0.023*
	(0.153)	(0.739)	(0.009)	(0.013)	(0.014)
Treatment	0.061	0.625	0.001	-0.004	-0.017
	(0.230)	(1.031)	(0.011)	(0.018)	(0.027)
Mock-Exam Score	0.310***	3.417***	0.028***	0.061***	-0.032***
(z-score)	(0.112)	(0.545)	(0.007)	(0.010)	(0.009)
Mean DepVar	9.412	63.597	0.187	0.314	0.407
Nb. of Observations	2293	2293	2293	2293	2293
R-squared	0.044	0.328	0.208	0.242	0.213
Nb. of Clusters	90	90	90	90	90

OLS estimates. School clustered standard errors in parentheses.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table : Heterogenous Treatment Effects: Academic Performance Back

Dependent Variable	Standardized Score in the Admission Exam		
Sample	All	Upward-updaters	Downward-updaters
	(1)	(2)	(3)
Treatment × (Upward-updater)	-0.068		
	(0.056)		
Treatment × (Downward-updater)	-0.095**		
	(0.043)		
Upward-updater	-0.094**		
	(0.043)		
Treatment		-0.075	-0.005
		(0.065)	(0.042)
Treatment × (Federal District)		-0.093	-0.368***
		(0.125)	(0.094)
Federal District		0.060	0.214**
		(0.103)	(0.097)
Mean Dep. Var. in Placebo	0.02	0.71	-0.12
Number of Observations	2253	437	1816
R-squared	0.713	0.750	0.659
Number of Clusters	90	84	90

OLS estimates. School clustered standard errors in parentheses.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table : Heterogenous Treatment Impacts on Beliefs

Back

Sample	Treatment & Placebo	
Dependent Variable	Mean Posterior	SD Posterior
Treatment	5.118	-0.042
	(4.136)	(2.269)
TreatXMean Prior	-0.194***	0.002
	(0.042)	(0.022)
Mean Prior	0.523***	-0.005
	(0.039)	(0.015)
TreatXSD Prior	0.121*	-0.148***
	(0.065)	(0.055)
SD Prior	-0.101**	0.591***
	(0.047)	(0.040)
Mean Dependent Variable in Placebo	75.61	17.45
Number of Observations	2293	2293
R-squared	0.429	0.368
Number of Clusters	90	90

NOTE: * significant at 10%; ** significant at 5%; *** significant at 1%. OLS estimates, standard errors clustered at the school level are reported in parenthesis. Sample of ninth graders in schools that belong to the treated and the placebo group. All specifications include a set of dummy variables which correspond to the randomization strata and a set of individual and school characteristics..