J-PAL
ABDUL LATIF JAMEEL POVERTY ACTION LAB

Education: The Supply Side

Esther Duflo

BREAD Development Economics Course

The COVID-19 pandemic is a tsunami on the education system in developing countries

- Over 300 Million children have been affected by school closure
- In many countries schools took over a year to re-open, and in some instances closed again immediately after they opened
- Catastrophic impact on learning levels

Catrastrophic impacts on learning level.

Table 7: % Children by grade and arithmetic level All schools 2018

Std	Not even 1-9	Recognize numbers		Subtract	Divide	Total
		1-9	10-99			
I	29.7	38.2	30.3	1.5	0.4	100
II	10.9	24.5	54.7	9.3	0.6	100
III	4.9	13.9	54.9	23.3	3.0	100
IV	2.9	7.3	48.2	29.5	12.1	100
V	2.3	5.1	38.0	34.1	20.5	100
VI	2.4	3.3	34.7	30.0	29.6	100
VII	1.1	2.1	36.1	27.2	33.6	100
VIII	1.0	1.3	32.0	26.6	39.0	100

Table 8: % Children by grade and arithmetic level All schools 2021

Std	Not even 1-9	Recognize numbers		Subtract	Divide	Total
		1-9	10-99			
I	42.6	36.1	19.5	1.4	0.4	100
II	22.5	35.0	36.7	5.0	0.8	100
III	10.7	24.7	47.3	15.7	1.6	100
IV	7.1	15.0	49.6	24.8	3.6	100
V	4.6	10.3	41.0	32.1	12.1	100
VI	2.6	5.6	32.0	35.3	24.5	100
VII	1.7	4.4	26.9	36.8	30.2	100
VIII	1.1	4.0	24.5	31.8	38.7	100

Karnataka, India, Comparing 2018 and 2021 (18k kids)

Catrastrophic impacts on learning level, continued.

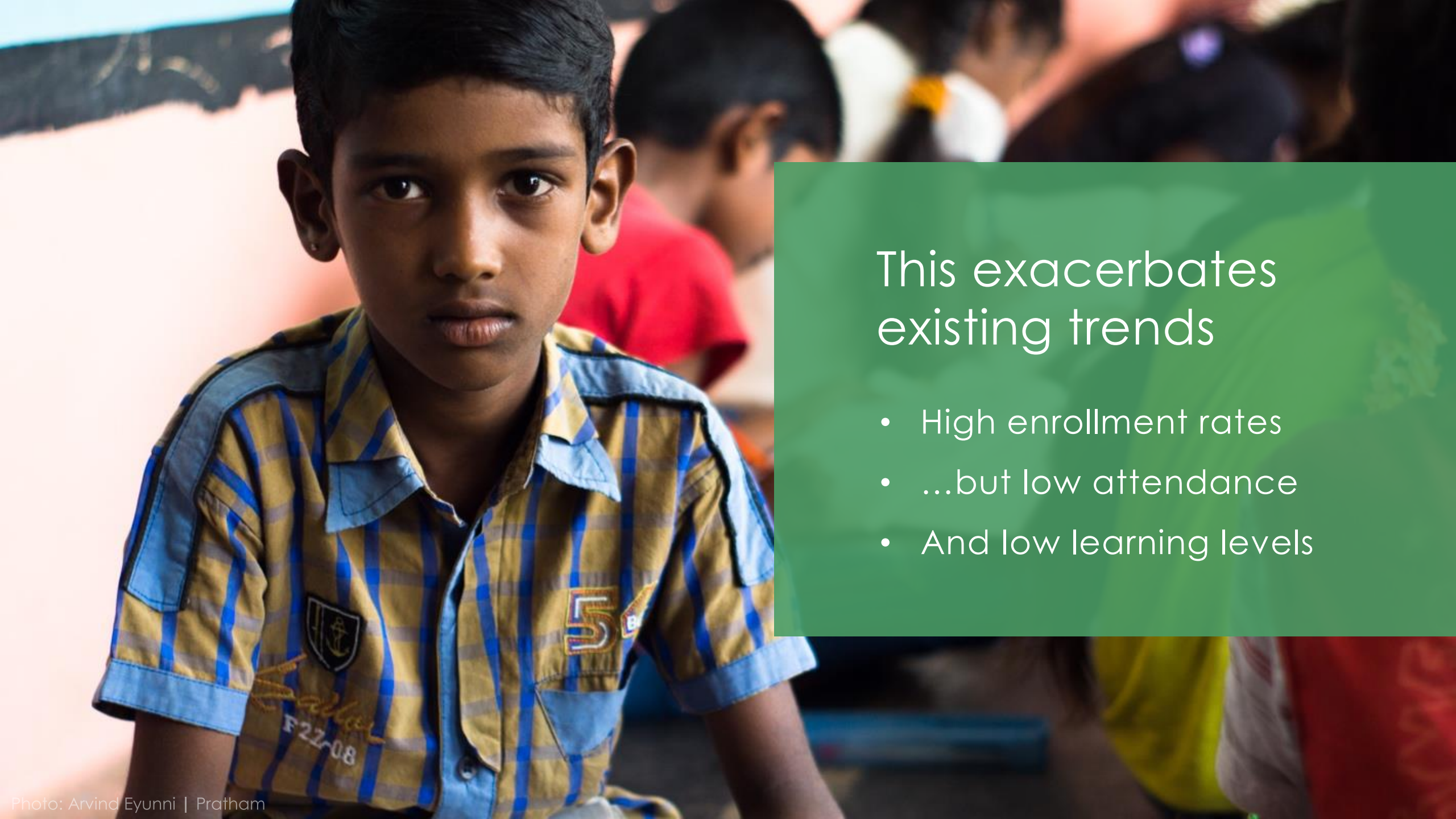
Table 3: % Children by grade and reading level All schools 2018

Std	Not even letter	Letter	Word	Std I level text	Std II level text	Total
I	40.3	39.9	15.4	2.5	1.9	100
II	17.2	31.7	30.6	13.0	7.6	100
III	9.2	19.8	30.3	21.5	19.2	100
IV	5.1	13.5	23.4	24.8	33.2	100
V	4.5	8.7	16.9	23.8	46.0	100
VI	4.2	6.7	12.8	20.5	55.8	100
VII	2.5	6.3	12.2	18.0	61.2	100
VIII	2.0	4.9	6.9	15.9	70.3	100

Table 4: % Children by grade and reading level All schools 2021

Std	Not even letter	Letter	Word	Std I level text	Std II level text	Total
I	56.8	29.4	10.5	1.6	1.7	100
II	31.8	37.3	21.5	6.2	3.3	100
III	16.5	29.5	30.5	13.7	9.8	100
IV	12.0	19.2	30.5	20.0	18.3	100
V	6.5	12.5	23.6	23.9	33.6	100
VI	3.9	7.9	14.6	23.8	49.8	100
VII	3.3	6.3	12.8	21.2	56.5	100
VIII	2.4	5.8	8.2	17.5	66.2	100

The reading tool is a progressive tool. Each row shows the variation in children's reading levels within a given grade. For example, in Table 3, among children in Std III, 9.2% cannot yet read letters, 19.8% can read letters but not words or higher, 30.3% can read words but not Std I level text or higher, 21.5% can read Std I level text but not Std II level text, and 19.2% can read Std II level text. For each grade, the total of these exclusive categories is 100%.



This exacerbates existing trends

- High enrollment rates
- …but low attendance
- And low learning levels

Photo: Arvind Eyunni | Pratham

Most children are going to school in India although they are absent a lot

Annual Status of Education Report
असर ASER 2014 RURAL
Facilitated by PRATHAM

Enrollment in school

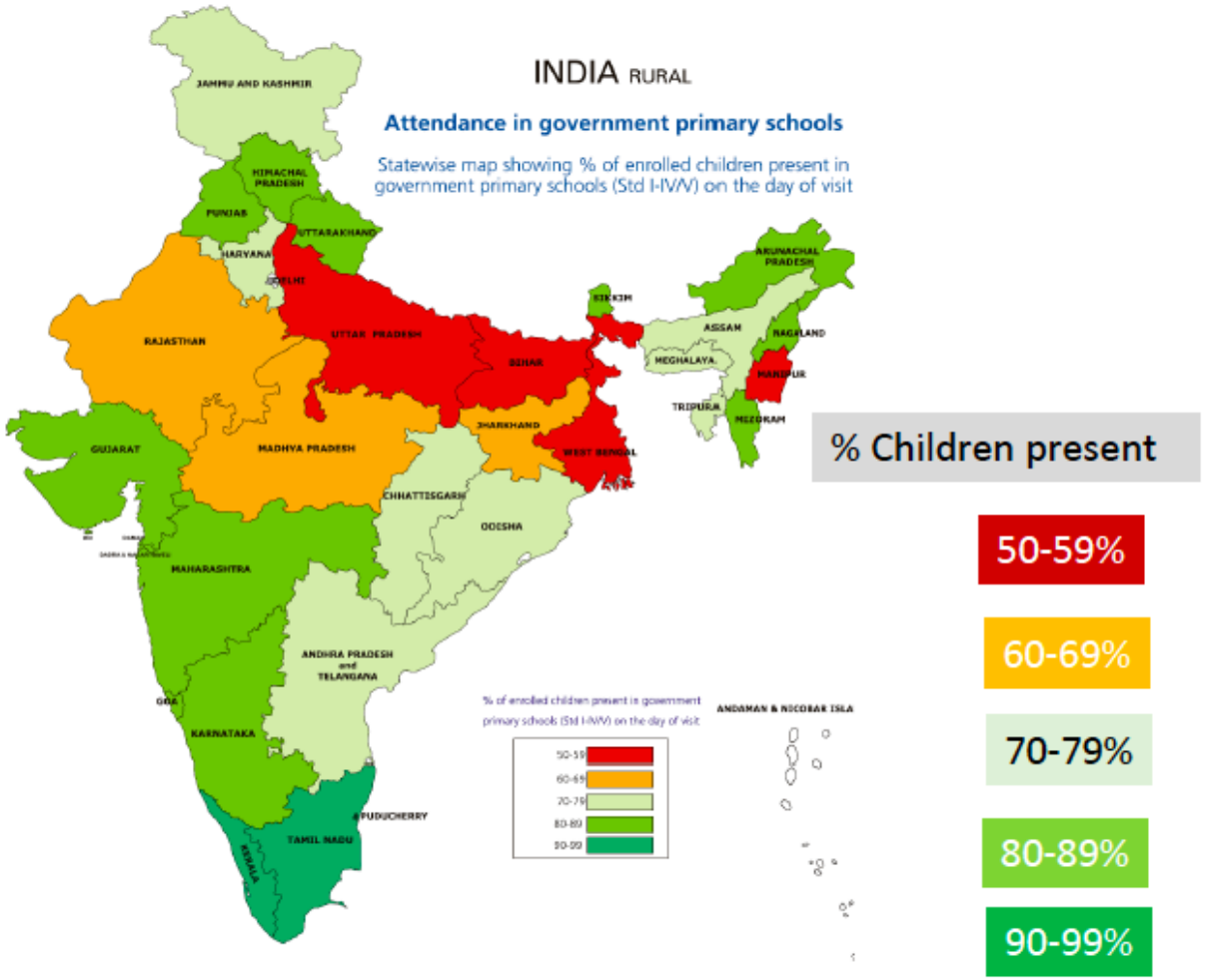
96.7% of children (in the age group 6-14 years) are enrolled in school in rural India.

2014 was the 6th year in a row that enrollmen rates have been 96% or above.

Attendance in school

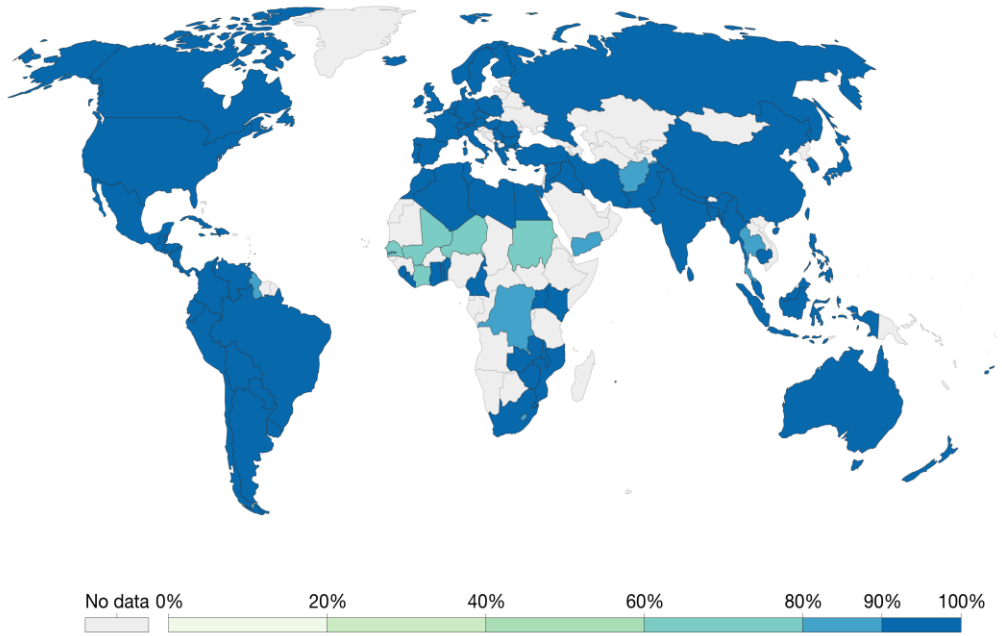
Visit to a government school on any random day in September, October or November shows about **71%** of enrolled children are attending school on that day.

However there is a lot of variation in daily attendance across states.



And around the world too

The share of children in primary school age who are in school, 2010



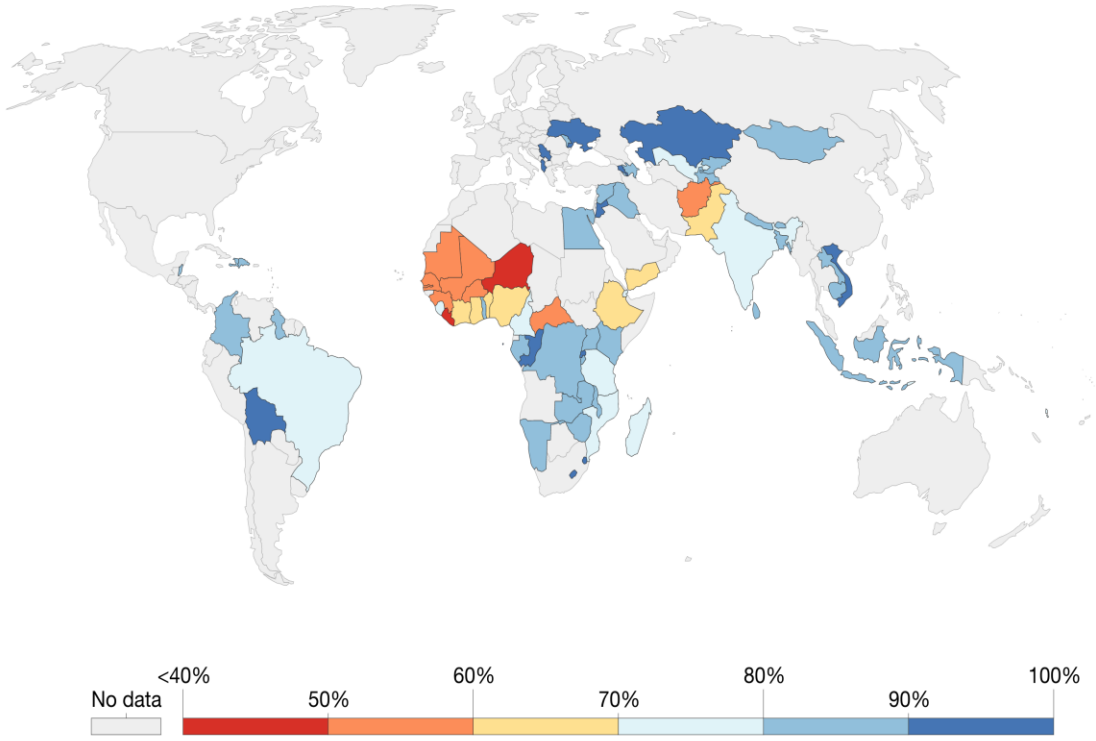
Source: Lee and Lee (2016)

OurWorldInData.org/global-rise-of-education • CC BY

Note: The ratio between primary school students and the number of children in the primary school age group. The enrollment ratios account for the repetition of grades and are taking differences in school ages between countries into account.

Net attendance rate of primary school, 2015

Total number of students in the theoretical age group for primary education attending that level, expressed as a percentage of the total population in that age group.



Source: UNESCO Institute for Statistics

OurWorldInData.org/primary-and-secondary-education • CC BY

School have been built, and when school is closer, people go

- Duflo (2001) INPRES school construction experiment in Indonesia

TABLE 3—MEANS OF EDUCATION AND LOG(WAGE) BY COHORT AND LEVEL OF PROGRAM CELLS

	Years of education			Log(wages)		
	Level of program in region of birth			Level of program in region of birth		
	High (1)	Low (2)	Difference (3)	High (4)	Low (5)	Difference (6)
Panel A: Experiment of Interest						
Aged 2 to 6 in 1974	8.49	9.76	−1.27	6.61	6.73	−0.12
	(0.043)	(0.037)	(0.057)	(0.0078)	(0.0064)	(0.010)
Aged 12 to 17 in 1974	8.02	9.40	−1.39	6.87	7.02	−0.15
	(0.053)	(0.042)	(0.067)	(0.0085)	(0.0069)	(0.011)
Difference	0.47	0.36	0.12	−0.26	−0.29	0.026
	(0.070)	(0.038)	(0.089)	(0.011)	(0.0096)	(0.015)
Panel B: Control Experiment						
Aged 12 to 17 in 1974	8.02	9.40	−1.39	6.87	7.02	−0.15
	(0.053)	(0.042)	(0.067)	(0.0085)	(0.0069)	(0.011)
Aged 18 to 24 in 1974	7.70	9.12	−1.42	6.92	7.08	−0.16
	(0.059)	(0.044)	(0.072)	(0.0097)	(0.0076)	(0.012)
Difference	0.32	0.28	0.034	0.056	0.063	0.0070
	(0.080)	(0.061)	(0.098)	(0.013)	(0.010)	(0.016)

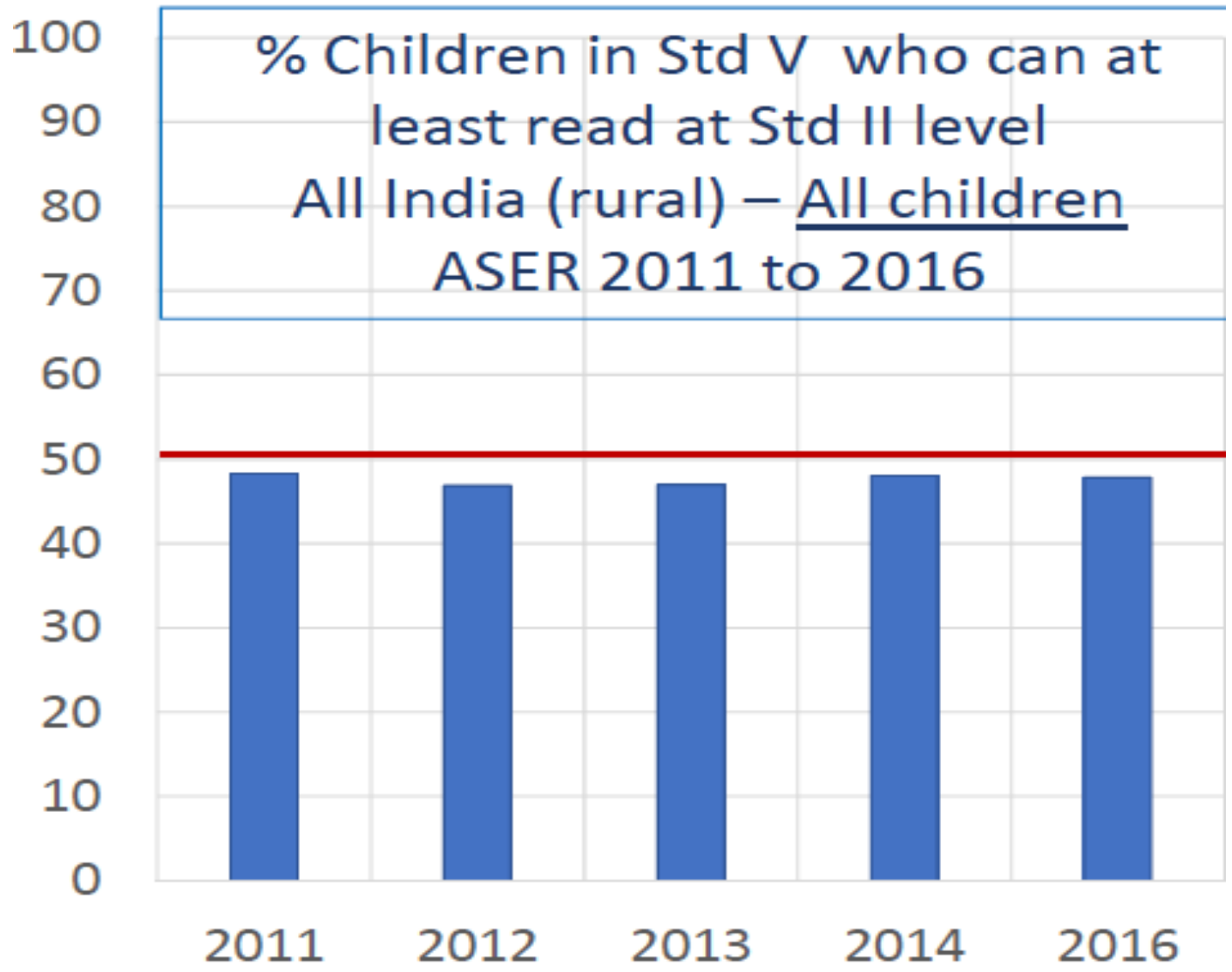
Notes: The sample is made of the individuals who earn a wage. Standard errors are in parentheses.

Duflo (2001)

FIGURE 3. COEFFICIENTS OF THE INTERACTIONS AGE IN 1974* PROGRAM INTENSITY IN THE REGION OF BIRTH IN THE WAGE AND EDUCATION EQUATIONS

Similar impact of school construction in Afghanistan (!) (Linden), large impact of cycle provision (Bihar) (Muralidharan and Prakash, 2017)

But they are not learning much

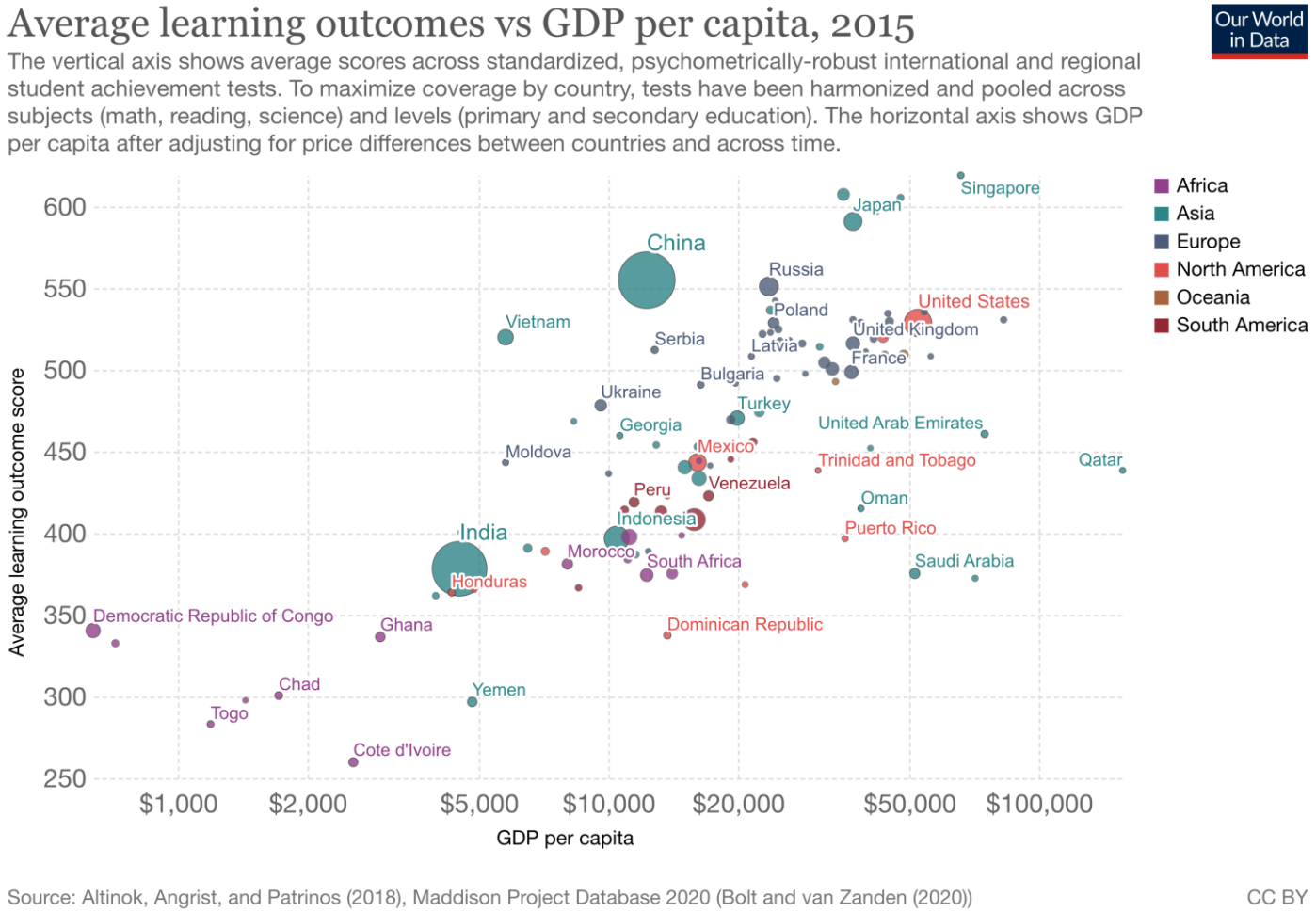


Annual Status of Education Report
असर ASER 2014 RURAL
Facilitated by PRATHAM

All India (rural): All children	
ASER 2014 Grade	% Children who can do subtraction
Std III	25.3
Std IV	40.2
Std V	50.5

All India (rural): All children	
ASER 2014 Grade	% Children who can do division
Std V	26.1
Std VI	32.2
Std VIII	44.1

And in the world (harmonized learning data from WB)



Going deeper: what schools miss

- Improvements in intuitive mathematics in pre-school does not lead to improvements in math in early grades
- Children who can do complicated mental arithmetics cannot do school arithmetic and vice versa.

Pre-school mathematicians (Dillon et al, 2016)

An experiment with 1,539 4-5 year old children in 214 Pratham-run preschool classes in Delhi

Classes randomized to 3 conditions:

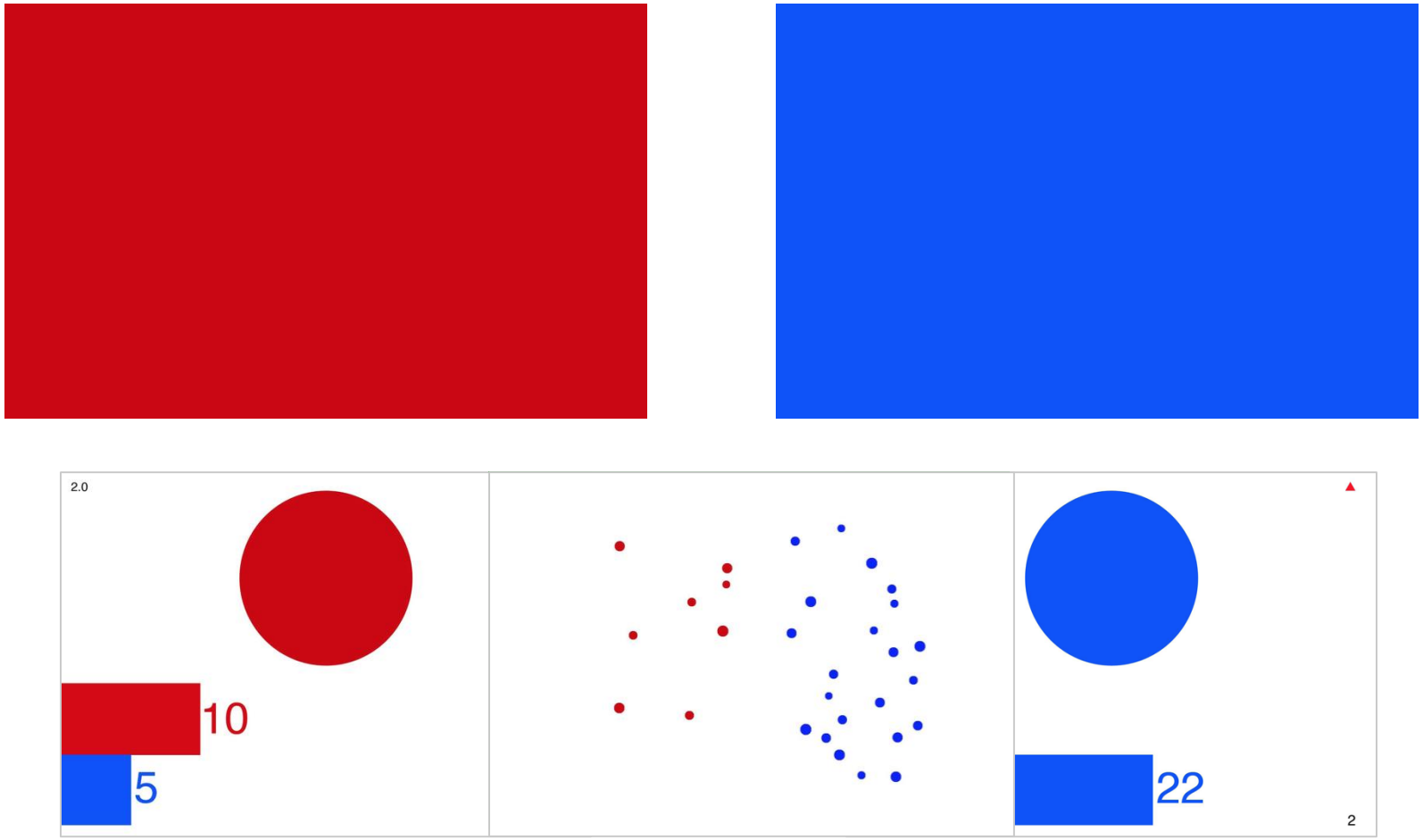
- Math games
- Social games (active control)
- Normal curriculum (no-treatment control)

12+ months study:

- Month 1: Pretest assessments
- Months 2-5: Games
- Month 6: First post-test assessments (~94% of sample)
- EL2, EL3 after kids have joined school

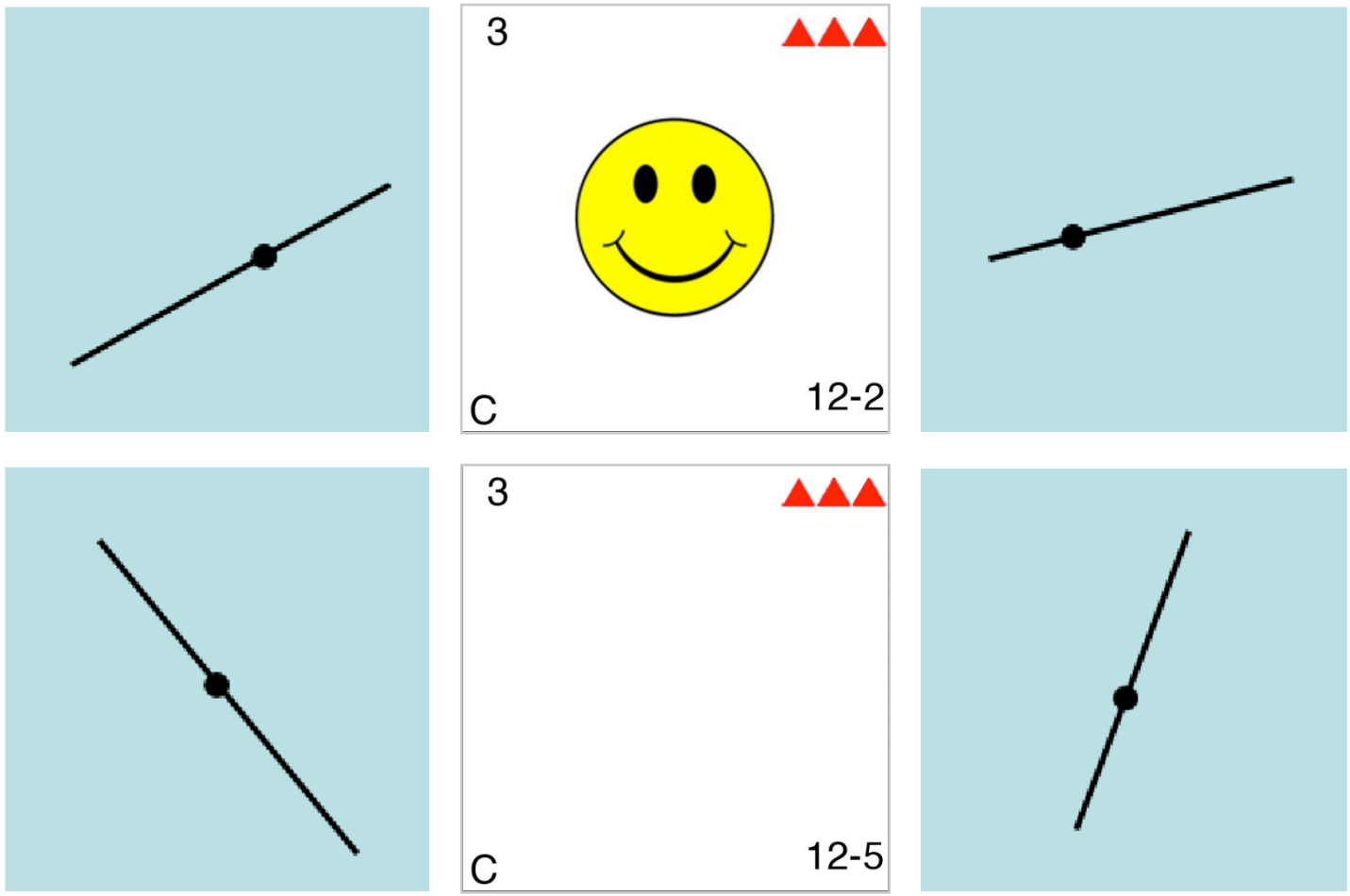
Numerical Comparison

Sorting a deck of cards: More red dots or blue dots?

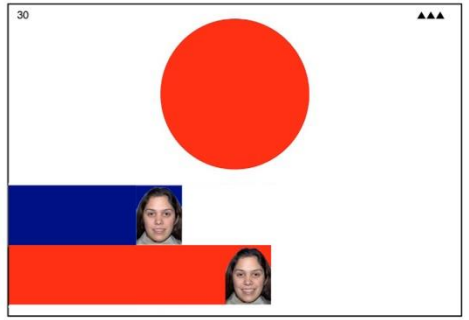


Visual Form Analysis

Which card doesn't belong with the rest?



Social games training sensitivity to emotion and gaze

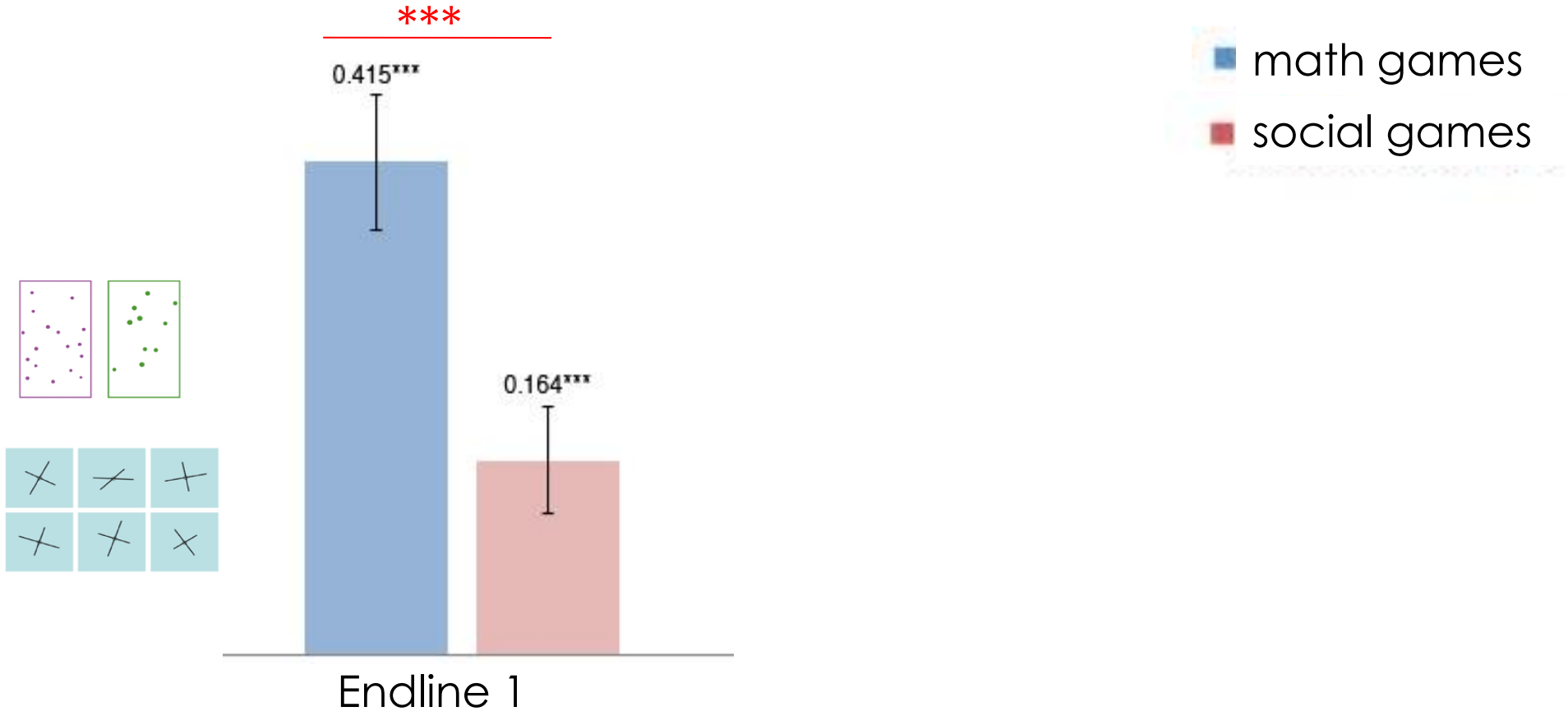


First finding

Even though the children had never played any games like these before, they learned to play as quickly and effectively as the children in the US, and they played as enthusiastically. Poor Indian children have an intuitive grasp of, and interest in, number and geometry.

Dillon, Kannan, Dean, Spelke & Duflo, Science 2017

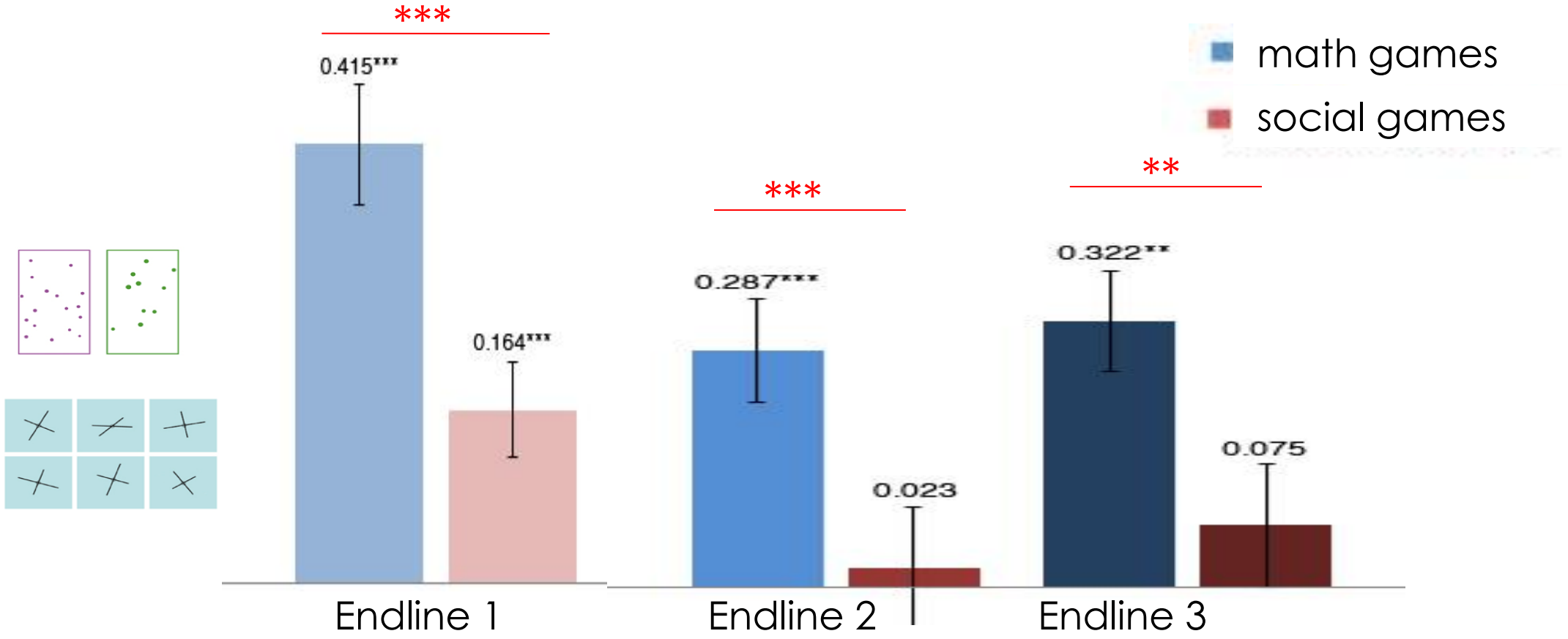
First finding
Immediate effects on the non-symbolic math tests



Children given math games were more sensitive to number/geometry than those given social or no games (opposite effects on social games).

NB: Black stars show significant treatment effects relative to no-treatment control.
Red stars show relative treatment effects of math and social games. **p<.01, ***p<.001

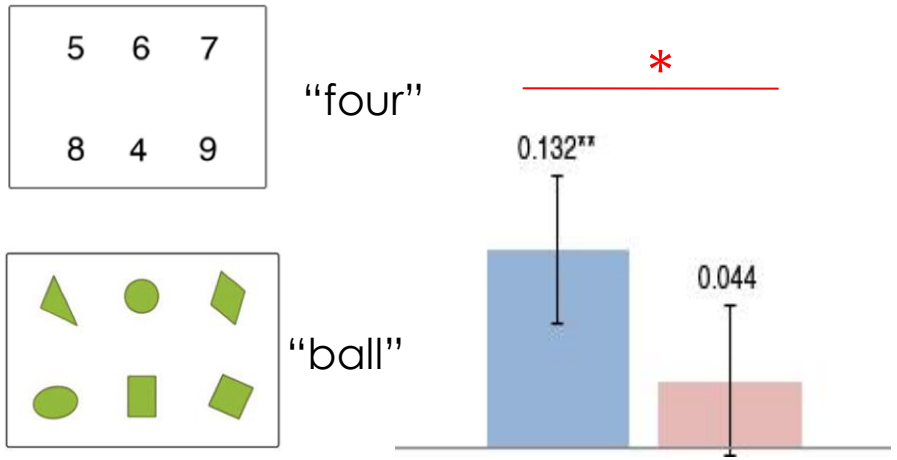
Second finding
The impact on non-symbolic math did not diminish over time



Even though children lost all access to the games a year earlier, the specific impact of the math games was as big at EL3 as at EL1.

NB: Treatment effects in percentage points, relative to no-treatment control.
Black stars show significant treatment effects relative to no-treatment control.
Red stars show relative treatment effects of math and social games. **p<.01, ***p<.001

Third finding
A weak but significant effect on symbolic math at EL1....



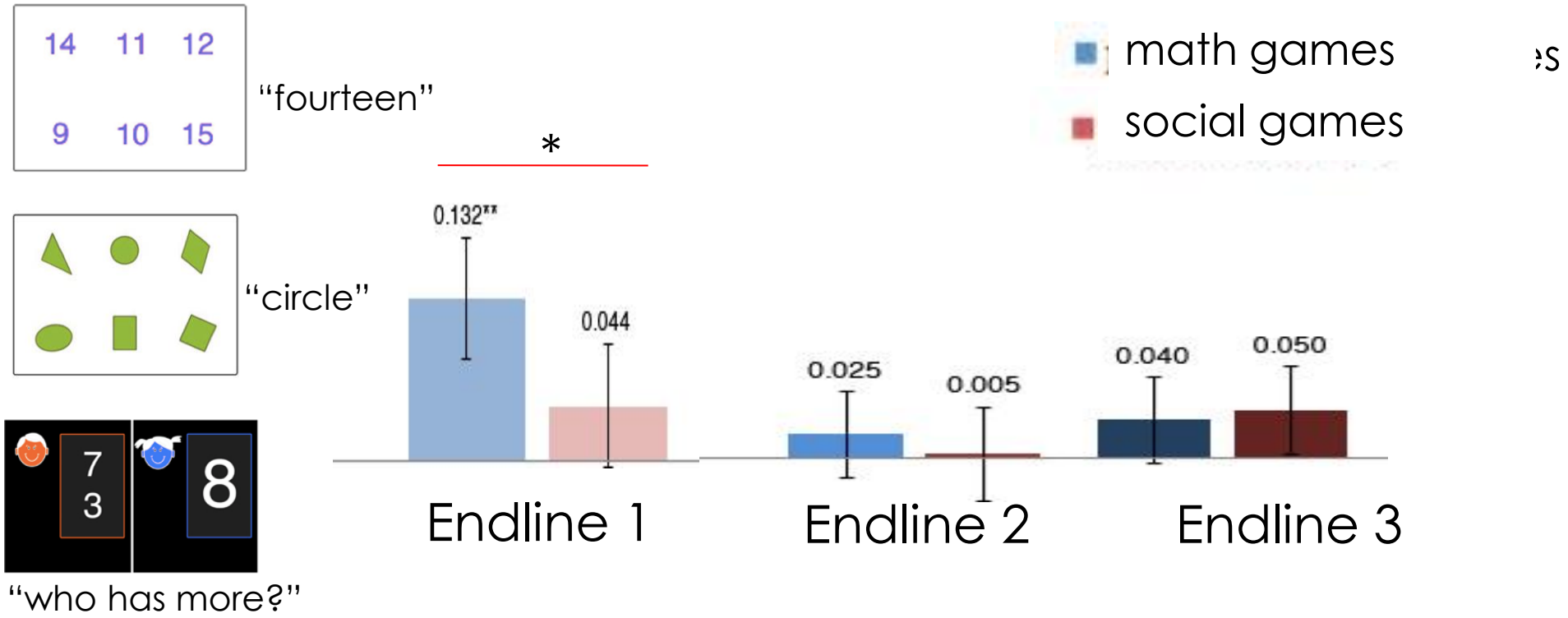
math games

social games

Endline 1

Children in the math games condition showed better mastery of Arabic numbers and of number words and shape names (as they do for US children).

...but this disappeared at later endlines

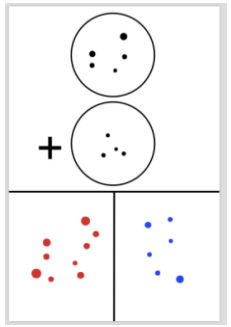


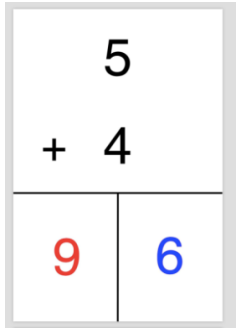
Although the math games enhanced the math language and symbols used in preschool, they did not enhance children's learning of symbolic math in primary school.

Conclusion from the first study

Playing non-symbolic math games, in a good nursery school, is not sufficient for enhancing children's readiness for learning school mathematics.

Schools are not able to leverage increased mathematical ability





The Market Math studies (Banerjee et al, 2022)

- **Kolkata** (201 children in 92 markets)
- **Delhi** (400 children in 39 markets)
  - 3 pair of **"mystery shoppers" bought goods** from children
  - Then children were invited to participate in the study:
    - **Written assessment** of school arithmetic (ASER study)
    - **Oral assessment** of school arithmetic
      - **Simple** problems
      - **"Anchored"** problems
      - Increasingly unfamiliar **hypothetical** transactions
        - Different price
        - Different unit (i.e., kilo or unit)
        - Different price and unit
  - School children in delhi invited to do simulated market transaction


School children were asked the same math questions and asked to do simulated market transactions

Working children use arithmetic effectively on their jobs.

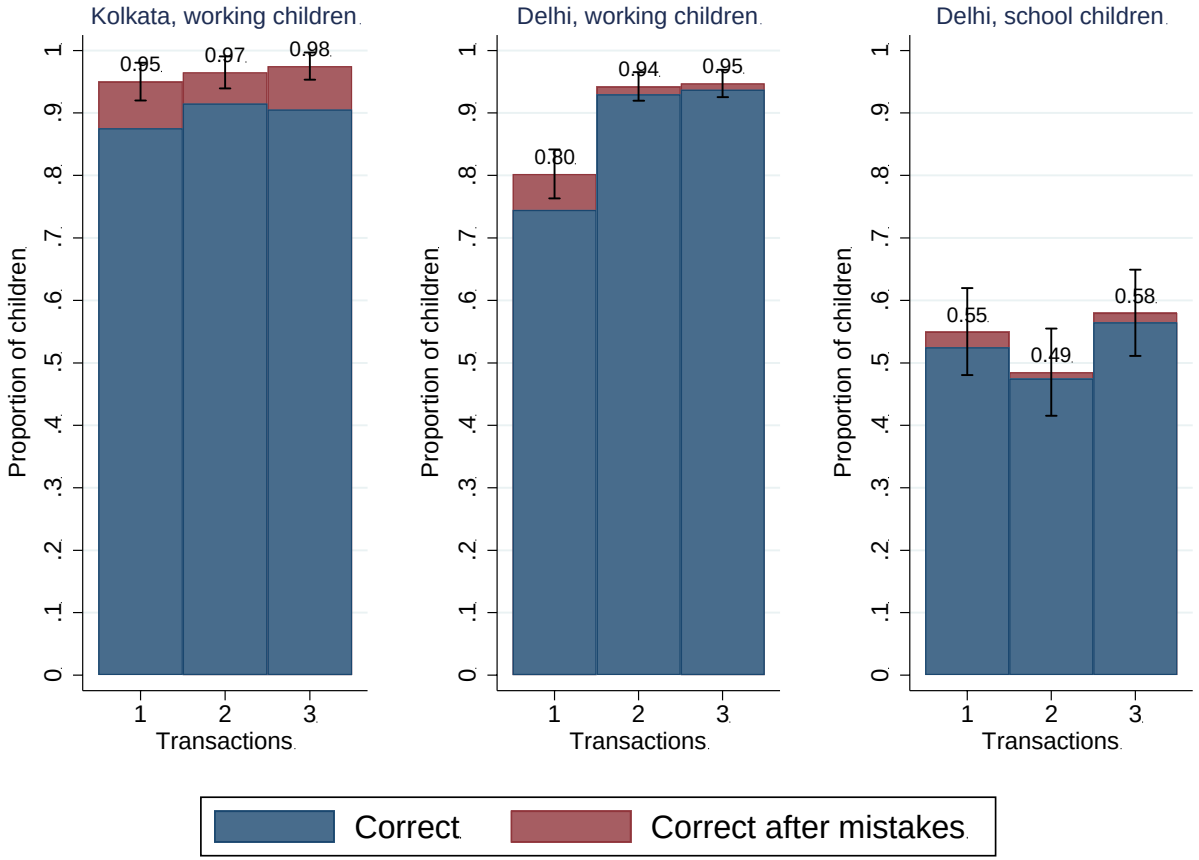


Figure 1. *Proportion of working and school children, by city, who calculated the total amount due in transactions involving two goods sold by the child in unusual quantities. Correct performance requires the child to perform two correct multiplications or divisions followed by a correct subtraction. Error bars indicate 95% CIs around the mean of both variables combined (correct and correct after mistakes).*

Calculation approaches *Performance of children by schooling* *Performance of working children and adults*

The arithmetic skills of working children are flexible, within the realm of market transactions.

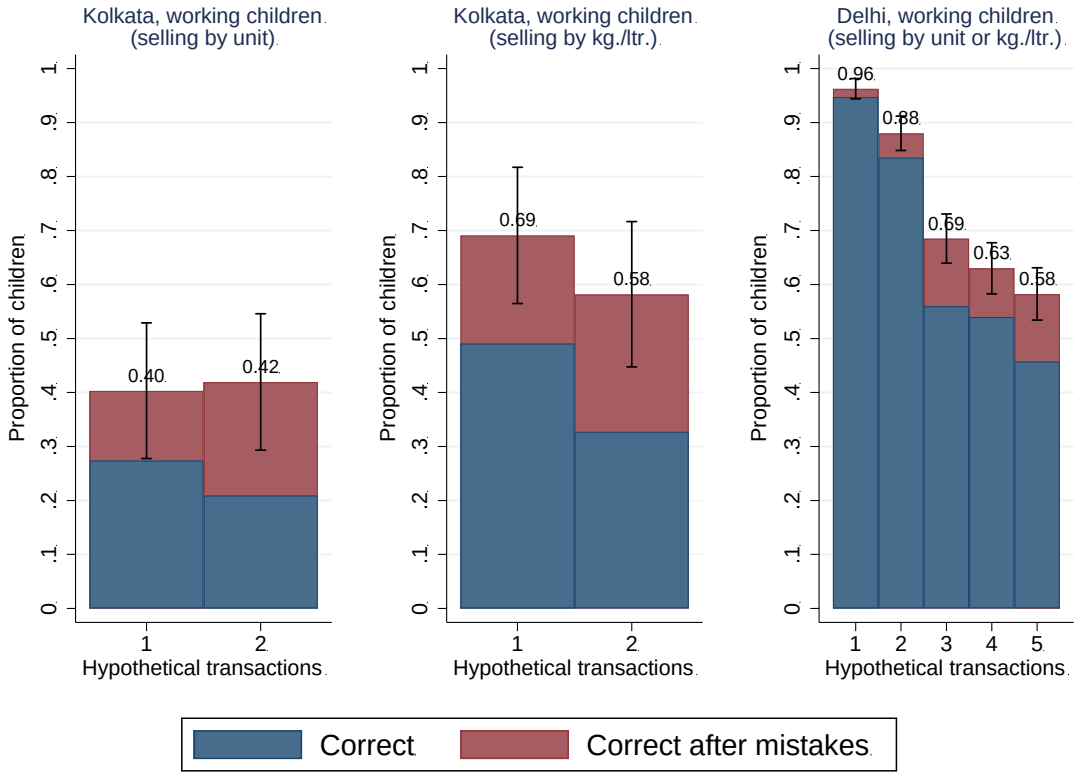


Figure 2. *Proportion of working children who calculated the total amount due in hypothetical transactions correctly. In Kolkata, a subset of 117 children were presented with the same two problems. The first two panels display the proportion of working children in Kolkata who answered these two hypothetical transactions correctly, depending on whether they sold goods by unit or kilogram/liters. In Delhi, each child was presented with a different set of five problems, depending on whether they sold goods by unit or kilogram/liters. The third panel displays the proportion of working children in Delhi who answered these hypothetical transactions correctly, grouping children who sold goods by unit and kilogram/liters. Error bars indicate 95% CIs around the mean of both variables combined (correct and correct after mistakes).*
Performance by type of goods sold *Performance by schooling*

Despite their success in markets, working children struggle with school mathematics.

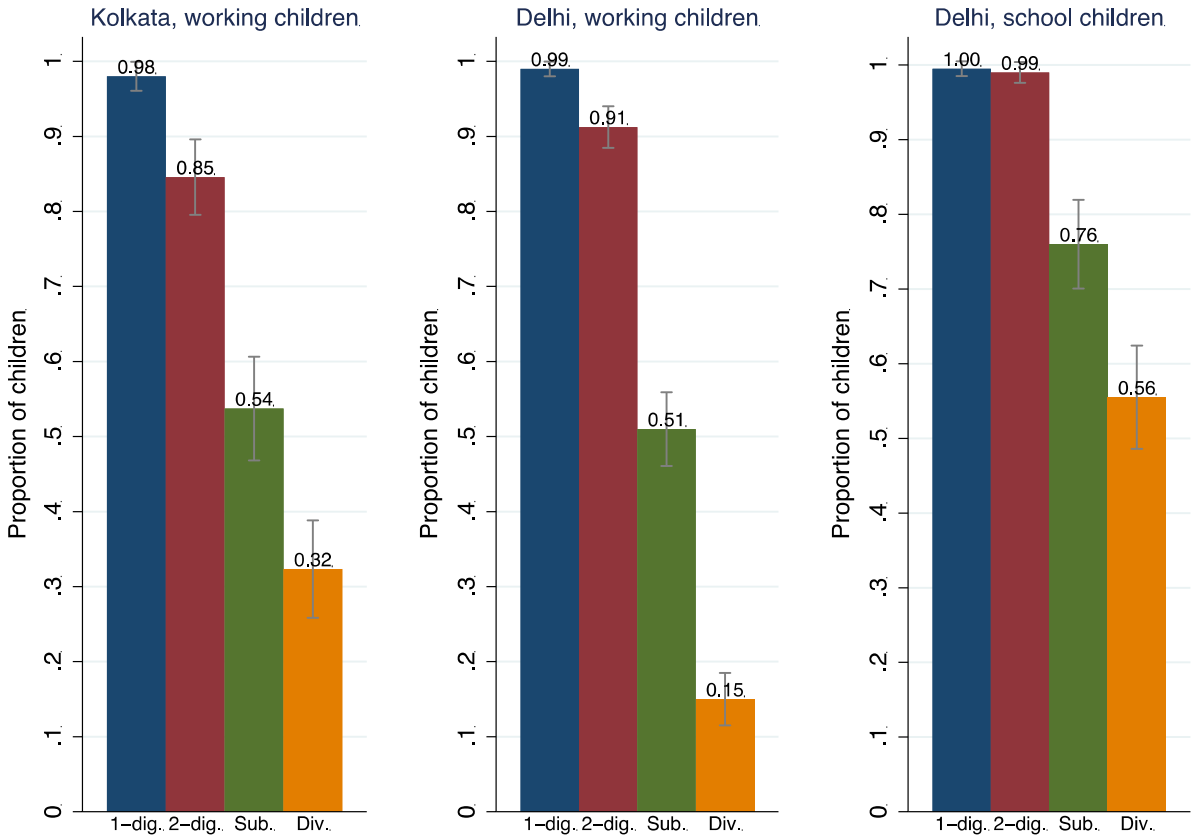


Figure 3. *Proportion of working children at each level of a written assessment of number recognition and arithmetic by city. Error bars indicate 95% CIs around the mean. Only 2% of children in Kolkata and 1% of children in Delhi failed to recognize one-digit numbers.*

Performance by type of goods sold *Performance on oral assessment*

Market children fail at school mathematics primarily because of their abstract presentation.

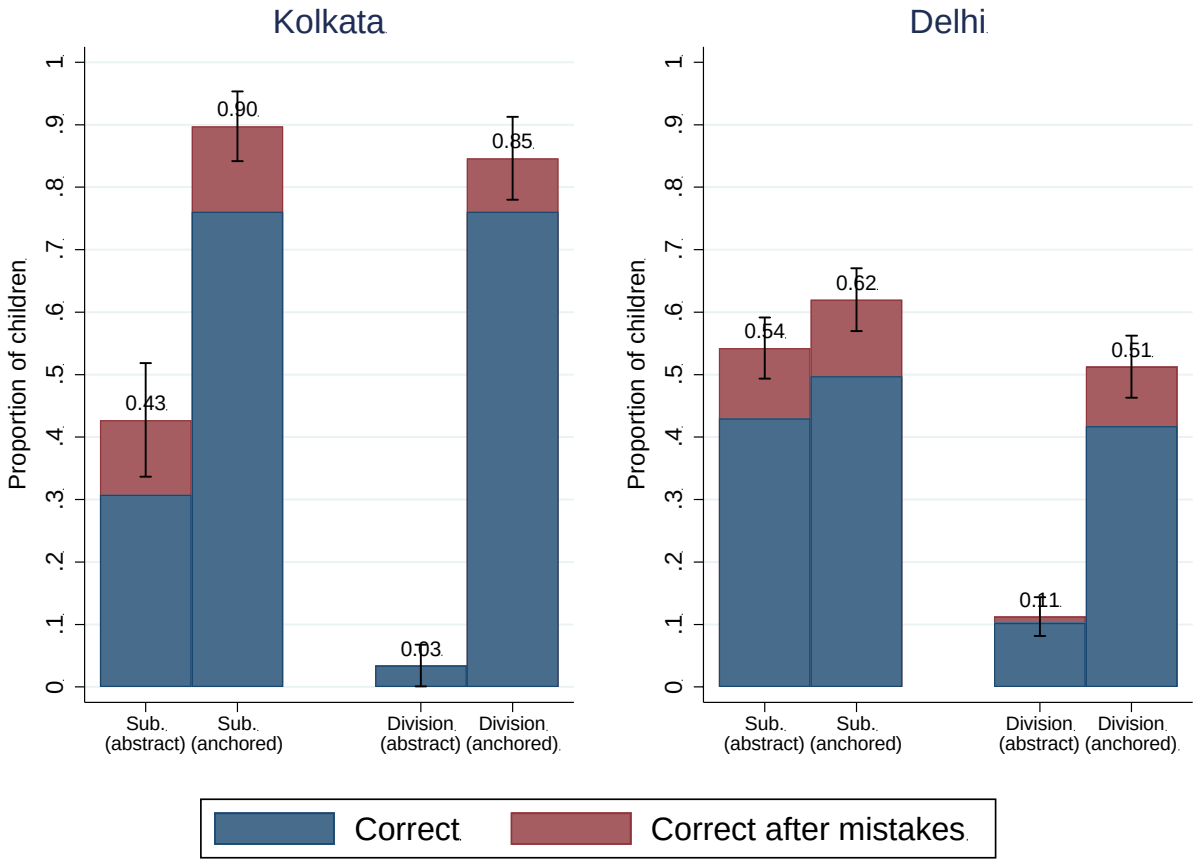


Figure 4. *Proportion of working children, by city, who solved a single oral subtraction or division problem correctly, depending on whether it was framed in the abstract form or in terms linked to goods and money. Error bars indicate 95% CIs around the mean of both variables combined (correct and correct after mistakes). In Kolkata, these questions were only administered to 117 of the 201 children in the study.*

Calculation approaches in market transactions *Calculation approaches in written assessment*

And yet, market children are able to fall back on efficient strategies even for abstract problems if they can be rounded.

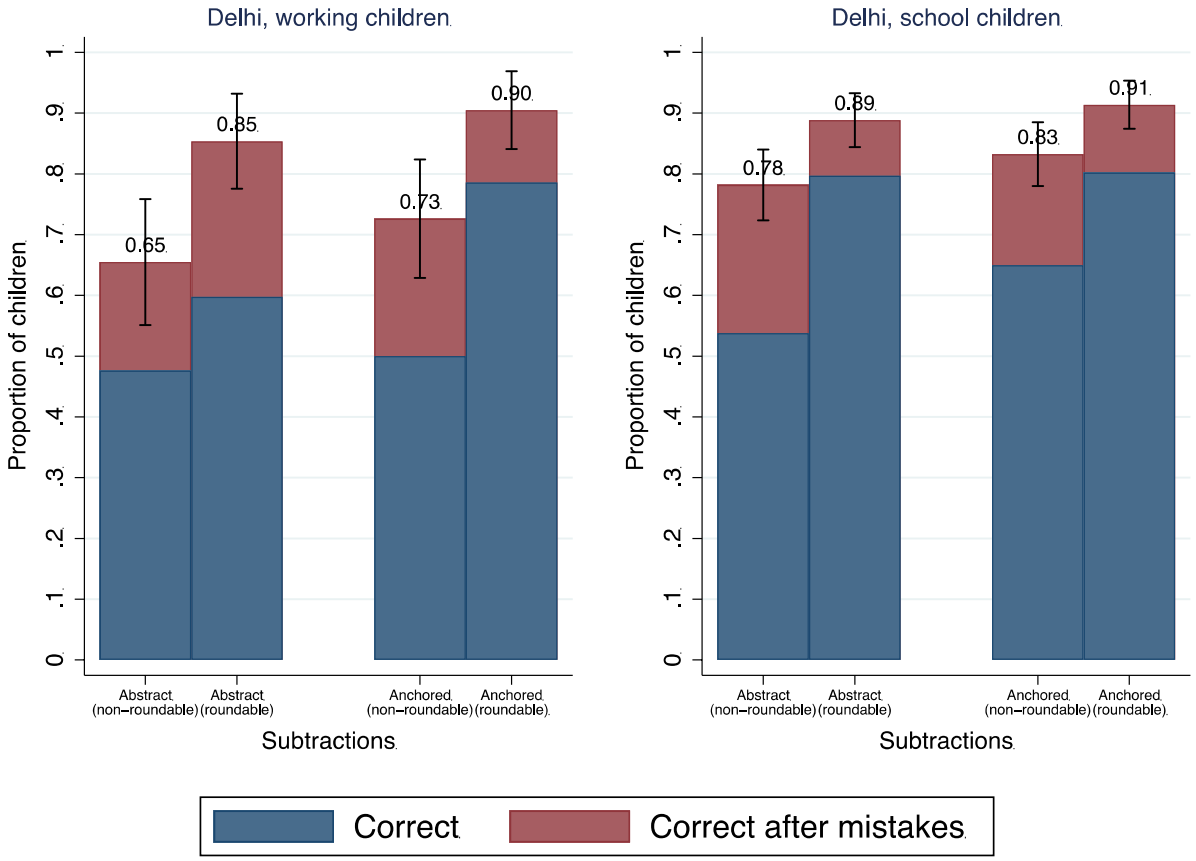


Figure 5. *Proportion of working children in Delhi who solved a single subtraction problem correctly, depending on whether it was framed in the abstract form or in terms linked to goods and money, and whether it was roundable or not (only for the subset of children who completed both sets of exercises). Error bars indicate 95% CIs around the mean of both variables combined (correct and correct after mistakes).*

[Performance of working and school children]

And yet, market children are able to fall back on efficient strategies even for abstract problems if they can be rounded.

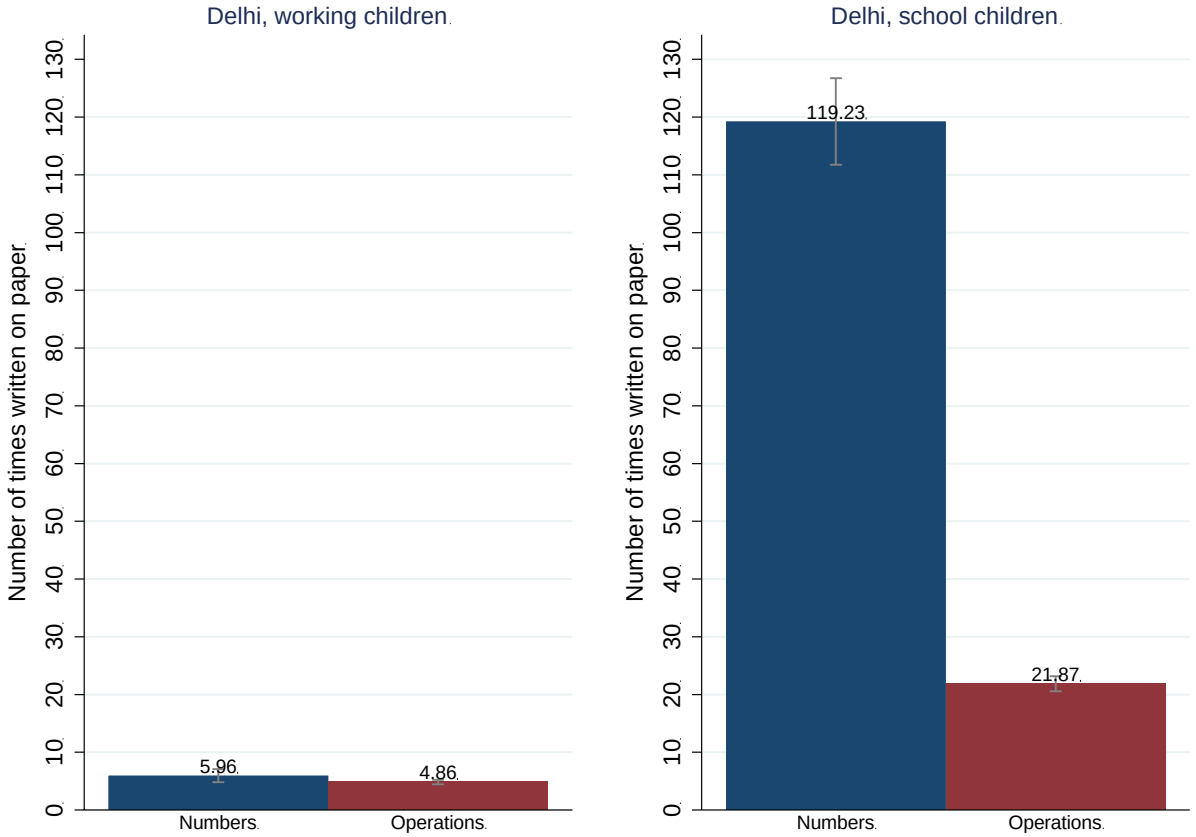
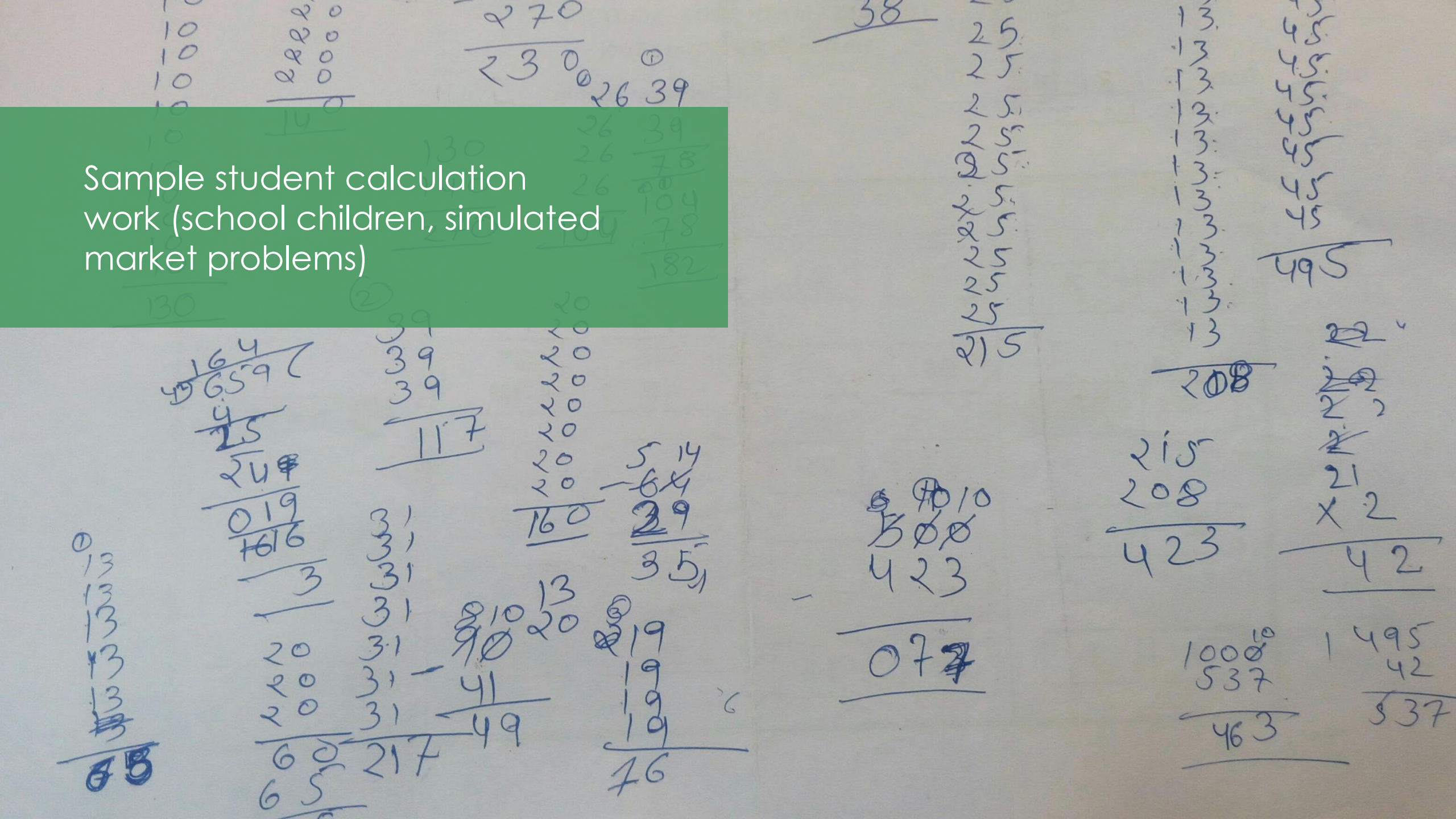


Figure 6. *Number of times that working and school children wrote numbers and operations in the paper given to them for the non-oral exercises.*
Pictures of calculations by school children *Written calculations of working and school children*


Sample student calculation work (school children, simulated market problems)

So the problem is deeper than schools not teaching much

- They don't recognized or leverage existing knowledge (abstract or concrete)
- What little they teach is useless for life

What the problem is (mainly) not

- Children are undernourished, parents are not helping, etc: children cannot learn.
- Teacher salary & other resources
- Incentives to do the job (as teachers understand it).

Children in India have the same fundamental learning processes as children in the US

- Among pre-school mathematicians, we find the same non-symbolic abilities in India as is typically found in US studies
- Moreover we find the same correlations between current and subsequent symbolic skills and the non-symbolic skills as in the US

Teacher salary and other resources

- Teachers are highly paid.
- Teachers salary are much higher in public than in (cheap) private schools that village children attend, yet performance in private school is at least as good (more evidence on that below)
- Non-permanent teachers who are paid a fraction of a regular teacher's salary are more effective.
- Large scale experiment in Indonesia to test the impact of doubling teacher pay led to NO increase in performance (De Rhee et al. 2018)
- Evidence also suggest no impact of cutting class size with no other changes in pedagogy in India, Kenya, etc.

Teacher incentives

- Directing incentive to specific things does help:
  - In Udaipur (Rajasthan), Duflo, Hanna, Ryan (2012) found that when teachers were given an incentives to attend, they attended more and children scored better at an endline test.
  - In Andhra Pradesh, Muralidharan and Sundararaman (2011) find that giving teachers incentives based on their children test scores led to increase in test scores
- However, private schools have the strongest incentives of all, since they survive based on parents' satisfaction.
  - The ASER test consistently find that children going to private schools do better than children who go to government schools
  - But this is entirely due to selection of children
  - In large RCT, Private schools tend to teach math and Telugu less well, thought they teach hindi and English (Muralidharan and Sundararaman, 2015)

Little impact on test scores

Except hindi and English which are not taught in public schools but are taught in private school

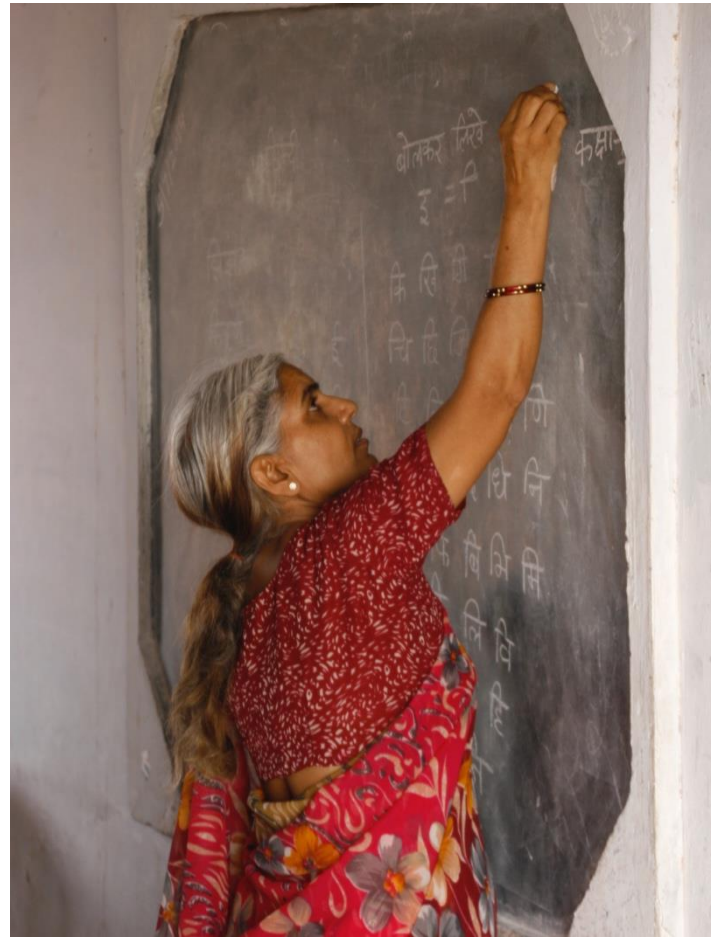
TABLE VI

TEST SCORE IMPACTS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Year 2 assessments				Year 4 assessments						
	Telugu score	Math score	English score	Combined across tests	Telugu score	Math score	English score	EVS score	Combined across tests excluding Hindi	Hindi score	Combined across tests
Panel A: Impact of winning a voucher (intention to treat effects)											
Offered voucher	−0.079	−0.053	0.185**	0.016	−0.017	−0.031	0.116*	0.083	0.036	0.545***	0.133***
	(0.055)	(0.065)	(0.079)	(0.061)	(0.051)	(0.052)	(0.070)	(0.060)	(0.048)	(0.068)	(0.045)
Total observations	4,620	4,620	4,525	13,765	4,385	4,385	4,217	4,243	17,230	1,696	18,926
Treatment observations	1,778	1,778	1,738	5,294	1,674	1,675	1,607	1,628	6,584	867	7,451
Control observations	2,842	2,842	2,787	8,471	2,711	2,710	2,610	2,615	10,646	829	11,475
Panel B: Average treatment on the treated (ATT) effect of attending a private school (scaling up intention to treat effect by inverse of voucher take-up rate)											
Voucher recipient in private school	−0.156	−0.104	0.364**	0.032	−0.033	−0.061	0.229*	0.164	0.071	1.074***	0.262***
	(0.108)	(0.128)	(0.156)	(0.120)	(0.100)	(0.102)	(0.138)	(0.118)	(0.095)	(0.134)	(0.089)
Total observations	4,620	4,620	4,525	13,765	4,385	4,385	4,217	4,243	17,230	1,696	18,926
Voucher recipients	997	997	982	5,294	945	946	911	920	6,584	510	7,451
Nonrecipients	3,623	3,623	3,543	8,471	3,440	3,439	3,306	3,323	10,646	1,186	11,475

The tyranny of the curriculum

- If kids can learn and teachers do teach, could the problem be that teachers are not teaching the right material?
- "Tyranny of the curriculum": no matter what children can do, you cannot afford not to complete the curriculum.



A snapshot of grade 4 curriculum, Haryana

Oct.	Math-Magic	Carts and Wheels	Understanding of circle using bangles, ropes etc. Understanding of radius of circle. Understanding of drawing a circle using compass.	7	2
		Halves and Quarters	Understanding of half, quarter, three-fourth etc.	4	2
	3rd Monthly Assessment in the last week				
Nov.	Math-Magic	Play with Patterns	Understanding of patterns. Understanding of pattern without numbers. Understanding of pattern with numbers and letters. Understanding of pattern with addition. Understanding of pattern using tiles.	7	2
		Table and Shares	Understanding of tables up to 15. Practice questions of division, word problems.	7	2
	4th Monthly Assessment in the last week				
Dec.	Math-Magic	How Heavy? How Light?	Understanding of heavier and heaviest. Understanding of weights of things in gms. and kg. Knowledge of weighing balance using different weights.	12	4
Jan.	Math-Magic	Fields and Fences	Understanding of perimeter of regular & irregular figures. Understanding of areas of regular & irregular pictures. Ability to solve word problems.	8	3

The tyranny of the curriculum

- If kids can learn and teachers do teach, could the problem be that teachers are not teaching the right material?
- "Tyranny of the curriculum": no matter what children can do, you cannot afford not to complete the curriculum.
- Not only an Indian problem. It is related to how elitist the curriculum is…
  - Same problem in Kenya… and in France!
  - Opposite situation in Finland, which has great test scores

Pratham
Every Child in School & Learning Well

TaRL Support Pieces

- IMPLEMENTATION TEAMS
- ASSESSMENT
- CLASSROOM METHODOLOGY
- MONITORING

In a TaRL classroom

STEP 1
ASSESSMENT
Test children on the basics using simple tools

STEP 2
GROUPING
Create homogene-ous learning level groups

STEP 3
FOUNDATIONAL SKILLS
Focus on basic skills for a period of the day or year

LEARNING OUTCOMES IMPROVE

Children are reassessed and moved through the levels as they progress.

Dr. Rukmini Banerji

Dr. Mdhav Chavan

For 15+ years of experimentation

Banerjee et al (2017)

2001-2003

"Balsakhi" program; Pratham community volunteer "pull out" remedial program in urban schools

2005-2006

Village volunteers conducted community classes for rural primary school children

2008

In-school one month gov't teacher-led summer camp with support by rural village volunteers

2008-2010

In-school gov't teacher-led learning improvement program & support by Pratham volunteers (rural)

2010-2013

Ghana trials of teacher-led vs. tutor-led in school and out of school

2012-2013

Teacher-led model; onsite mentoring by gov't academic officials

2013-2014

"Learning Camps" in gov't primary schools; led by Pratham teams supported by village volunteers

2000 — 2005 — 2010 — 2015

Pratham staff/volunteers in-school

Evaluation design:

- T1 (2, 20-day): 120 schools
- T2 (4, 10-day): 120 schools
- Control: 120 schools

Results:

- Huge gains (.7 s.d. in Hindi and math)
- Effect of "pure" TaRL model
- Cost effective (driven by huge gains)

Pratham staff/volunteers in-school

<u>Uttar Pradesh (2013-2014)</u>

Delivery: Pratham staff and volunteers

Location: In-school

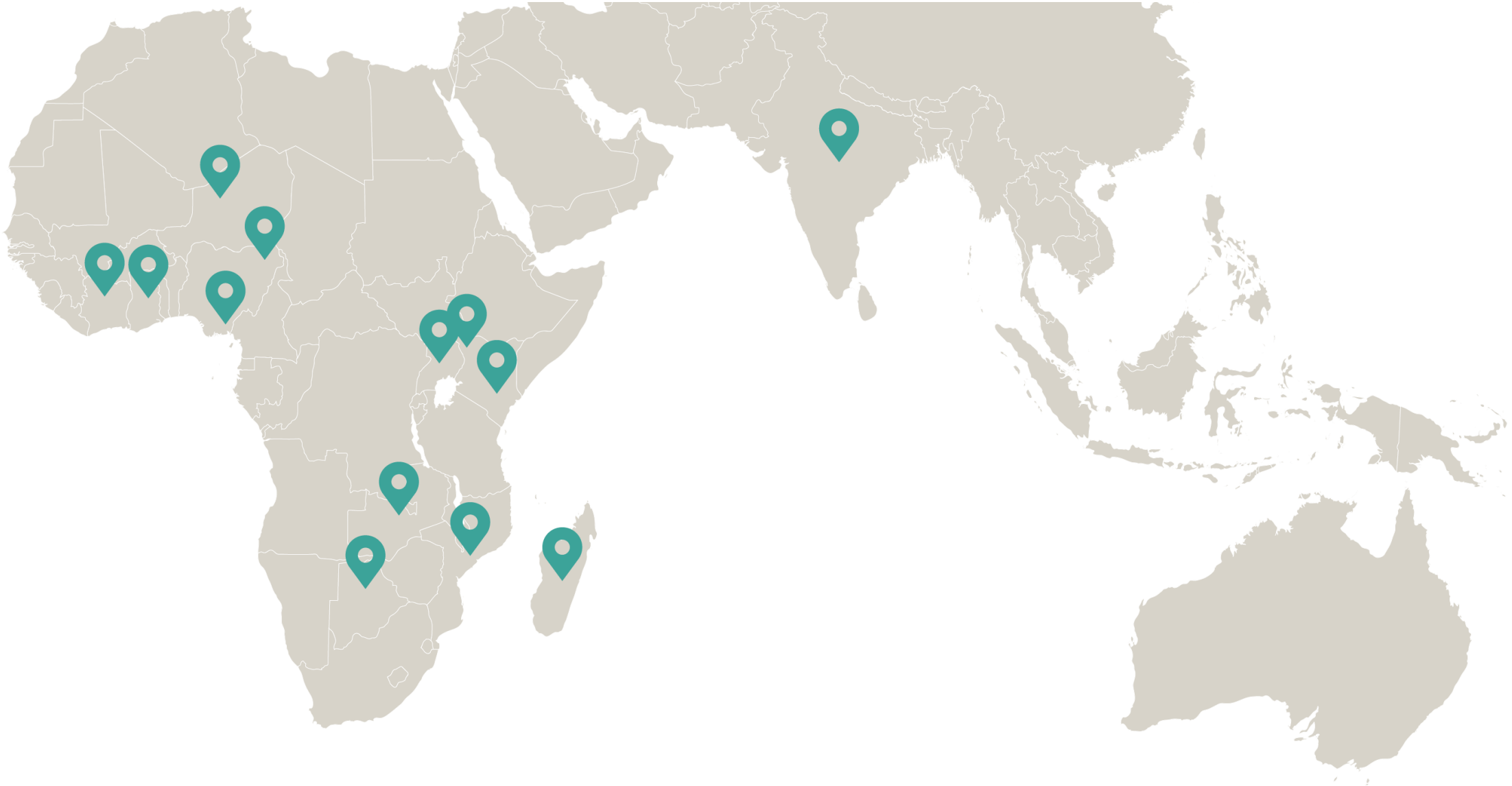
Timing: During school hours, 2 hours a day

Duration: 50 days

Special characteristics:

- Intensive camp model
- Dedicated time
- Grouping across Std 3-5

Teaching at the right level today: Scale up to millions in India and Africa under Pratham Leadership



Fixing primary education

- **Give up on schools?**
  - Pratham recent Digital efforts mainly out of school
  - Great potential, Remarkable impacts of some initatives (Garminian et al, RCT of mindspark, a software programs used during tutoring lessons)
  - Satisfying… but
- Schools continue to have the monopoly to test and legitimate knowledge
- Fundamental problem with this approach is that kids are in school, anything else requires convincing them to show up
  - First Read India program was out of school: very large effect on very few kids
  - Very low willingness to pay for Mindspark (the educational program)

Disrupting education?

- Lottery to give access to tuition with mindspark program, an AI based software to provide drills adapted to level to each child.

- Large impacts

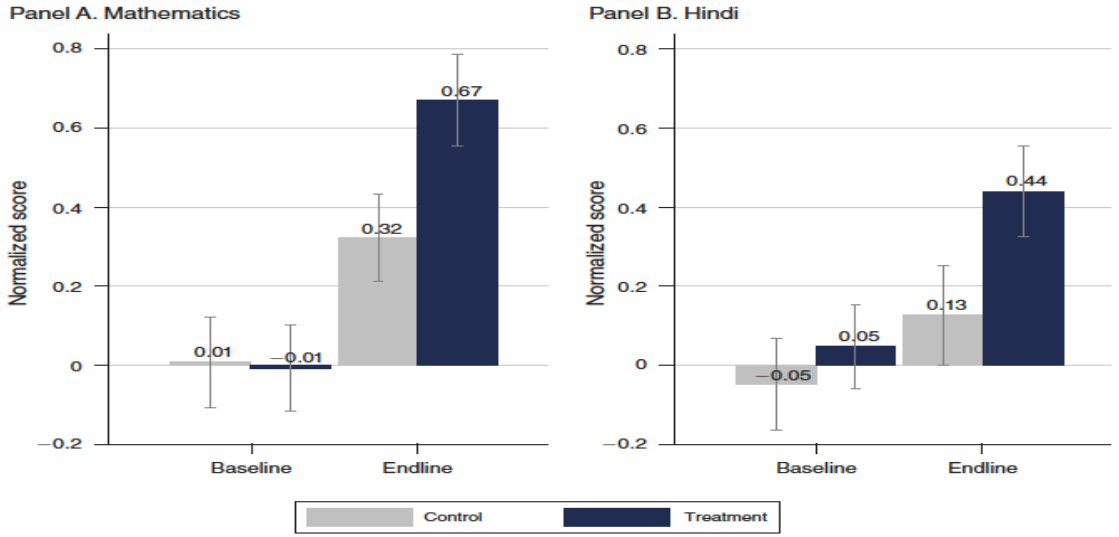


FIGURE 2. MEAN DIFFERENCE IN TEST SCORES BETWEEN LOTTERY WINNERS AND LOSERS

Notes: This figure shows mean of test scores, normalized with reference to baseline, across treatment and control groups in the two rounds of testing with 95 percent confidence intervals. Test scores were linked within-subject through IRT models, pooling across grades and across baseline and endline, and are normalized to have a mean of 0 and a standard deviation of 1 in the baseline. Whereas baseline test scores were balanced between lottery winners and lottery losers, endline scores are significantly higher for the treatment group.

Garminian et al, disrupting education

Impact throughout the distribution…
But no impact on grade level questions in math

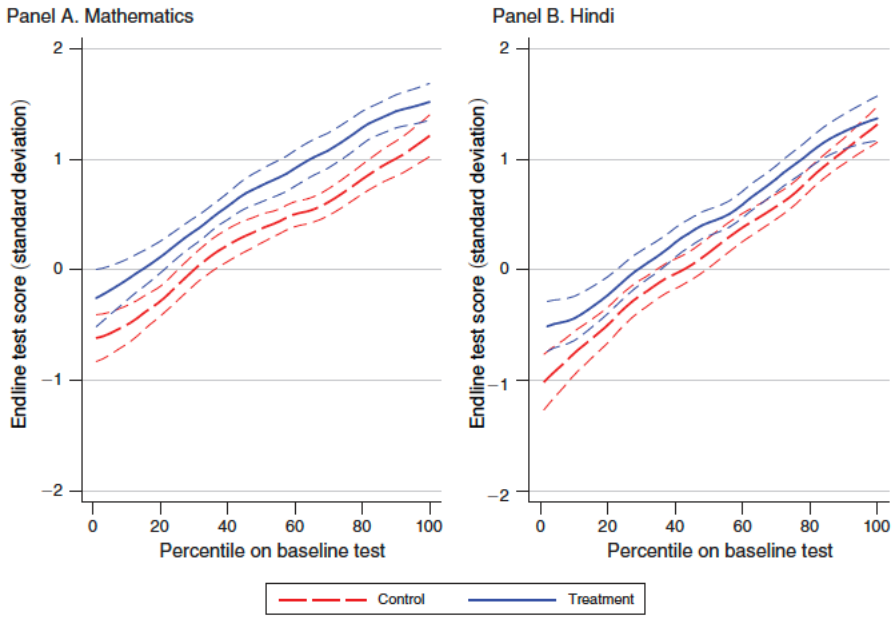


FIGURE 3. NONPARAMETRIC INVESTIGATION OF TREATMENT EFFECTS BY BASELINE PERCENTILES

TABLE 6—TREATMENT EFFECT ON ITEMS LINKED TO GRADE LEVELS

	Proportion of questions answered correctly			
	Math		Hindi	
	At or above grade level	Below grade level	At or above grade level	Below grade level
	(1)	(2)	(3)	(4)
Treatment	0.0089	0.081	0.063	0.050
	(0.032)	(0.013)	(0.027)	(0.014)
Baseline subject score	0.047	0.099	0.13	0.13
	(0.022)	(0.0069)	(0.016)	(0.0068)
Constant	0.31	0.49	0.45	0.58
	(0.022)	(0.0089)	(0.019)	(0.0100)
Observations	291	511	292	513
R^2	0.029	0.346	0.250	0.399

And hence moderate to no impact on school exams

TABLE 7—TREATMENT EFFECT ON SCHOOL EXAMS

	Standardized test scores					
	Hindi	Math	Science	Social sciences	English	Aggregate
	(1)	(2)	(3)	(4)	(5)	(6)
Treatment	0.196	0.059	0.077	0.108	0.081	0.100
	(0.088)	(0.076)	(0.092)	(0.110)	(0.105)	(0.080)
Baseline Hindi score	0.487		0.292	0.414	0.305	0.336
	(0.092)		(0.064)	(0.096)	(0.067)	(0.058)
Baseline math score		0.303	0.097	0.262	0.120	0.167
		(0.041)	(0.036)	(0.058)	(0.052)	(0.039)
Constant	1.006	0.142	0.931	1.062	1.487	0.977
	(1.103)	(0.423)	(0.347)	(0.724)	(0.740)	(0.600)
Observations	597	596	595	594	597	597
R^2	0.190	0.073	0.121	0.177	0.144	0.210

Notes: Robust standard errors in parentheses. This table shows the effect of receiving the Mindspark voucher on the final school exams, held in March 2016 after the completion of the intervention. *Treatment* is a dummy variable indicating a randomly assigned offer of a Mindspark voucher. Test scores in the school exams are normalized within school × grade to have a mean of zero and a standard deviation of one in the control group. All regressions include grade and school fixed effects.

- And no parent interest… and program had to stop

Despite the large test-score gains we find, parental demand for Mindspark centers was low in the absence of (fee-waiving) vouchers. In fact, all three centers in our study closed down soon after the conclusion of our experiment in the face of low parental willingness to pay (even at the subsidized price that was charged to the students outside our study who attended the Mindspark centers). The donors who subsidized the fees for regular students at Mindspark centers stipulated that they would only continue funding the subsidies if the centers could operate at or above 80 percent capacity (and thereby demonstrate parental willingness to pay at least the subsidized price). In practice, enrollment levels were considerably below this target, and the centers had to shut down because philanthropic funding for the subsidies ended.[35] Thus, models of

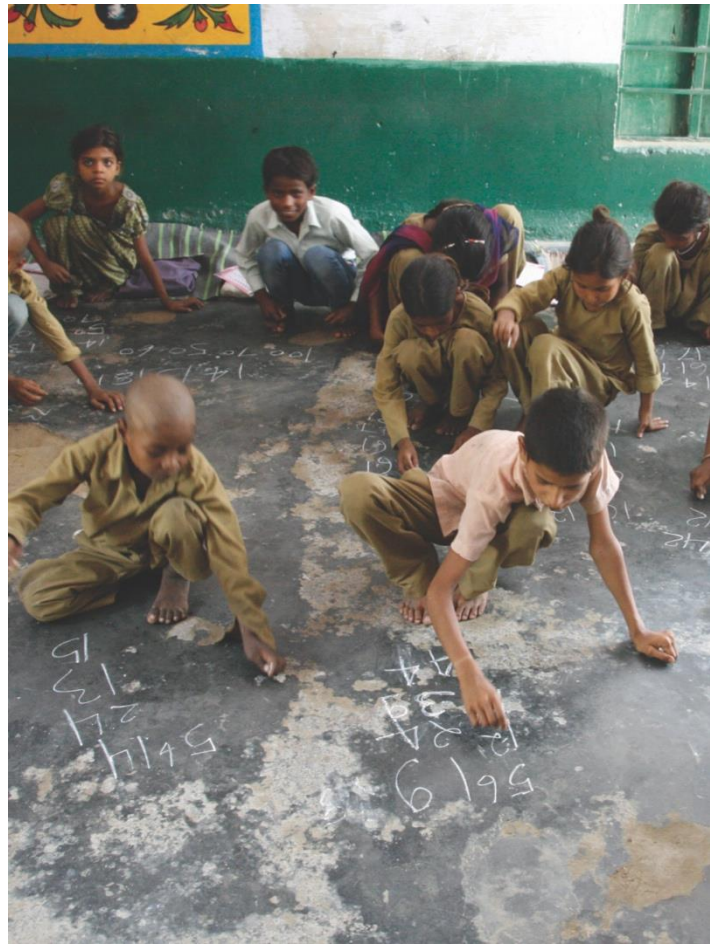
Fixing primary education

- **Give up on schools?**
  - Digital efforts mainly out of school
  - Great potential, Remarkable impacts of some initatives (Garminian et al, RCT of mindspark, a software programs used during tutoring lessons)
  - Satisfying… but
- Fundamental problem with this approach is that kids are in school, anything else requires convincing them to show up
  - First Read India program was out of school: very large effect on very few kids
  - Very low willingness to pay for Mindspark (the educational program)
- Schools continue to have the monopoly to test and legitimate knowledge
- Parents continue to buy into the obsession of elitism: schools is valuable for the possibilities it opens up (see the private school impacts, mainly on English and Hindi)-See Kenya and hope for large returns to secondary school education.

Fixing primary education

Changing the curriculum?

- That remains the holy grail: many of the problems of the system are ultimately anchored in the curriculum
- Tremendous opposition from the education world…
- We seem to be going the other way
- Partial efforts are counterproductive: Example of CCE evaluation in Haryana
- Glimmer of hope: Delhi. Massive tracking and decision not to finish curriculum in Delhi led to large gains before the pandemic.



Fixing primary education

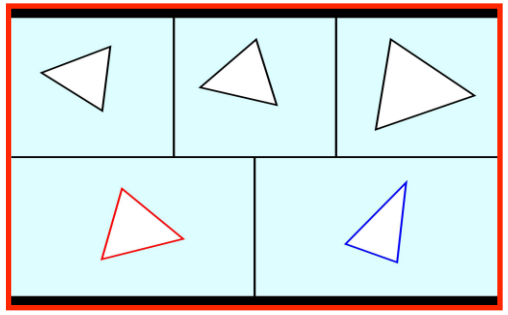
Working on the margins: Some parts of the system are more open

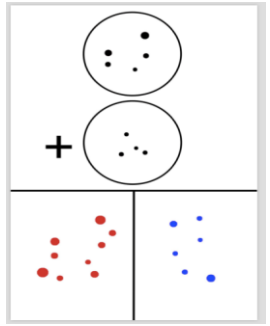
- Tutoring
- Completely defunct schools
- Pre-school
- Early Grade where it may be possible to complement the curriculum
- Summers

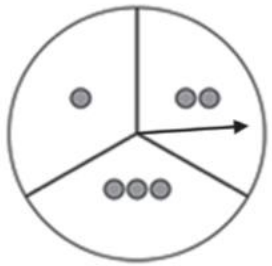
Preparing the kids better for primary school: Second experiment with of Duflo-Spelke team.

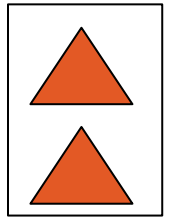
1896 children in 231 Delhi preschools.
4 conditions: non-symbolic math games, symbolic math games, mixed math games, no-treatment.

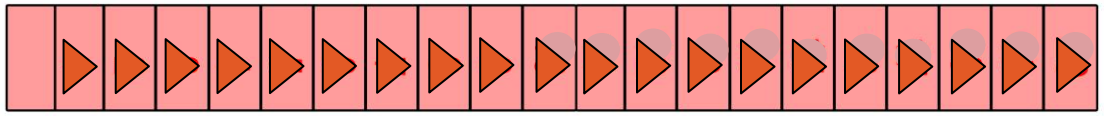
Non-symbolic games



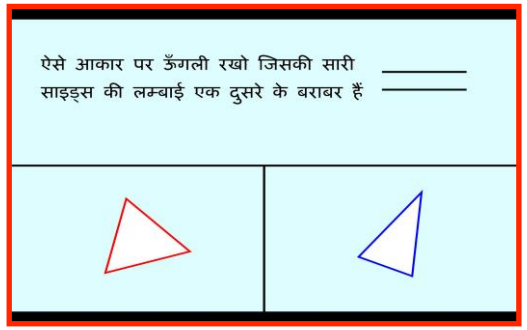


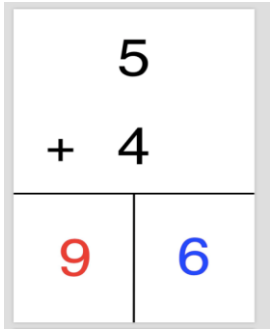


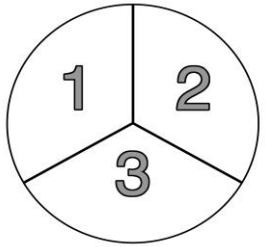


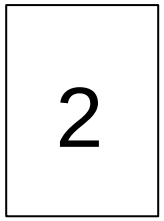


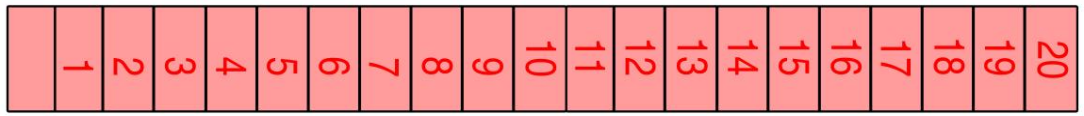
Symbolic games



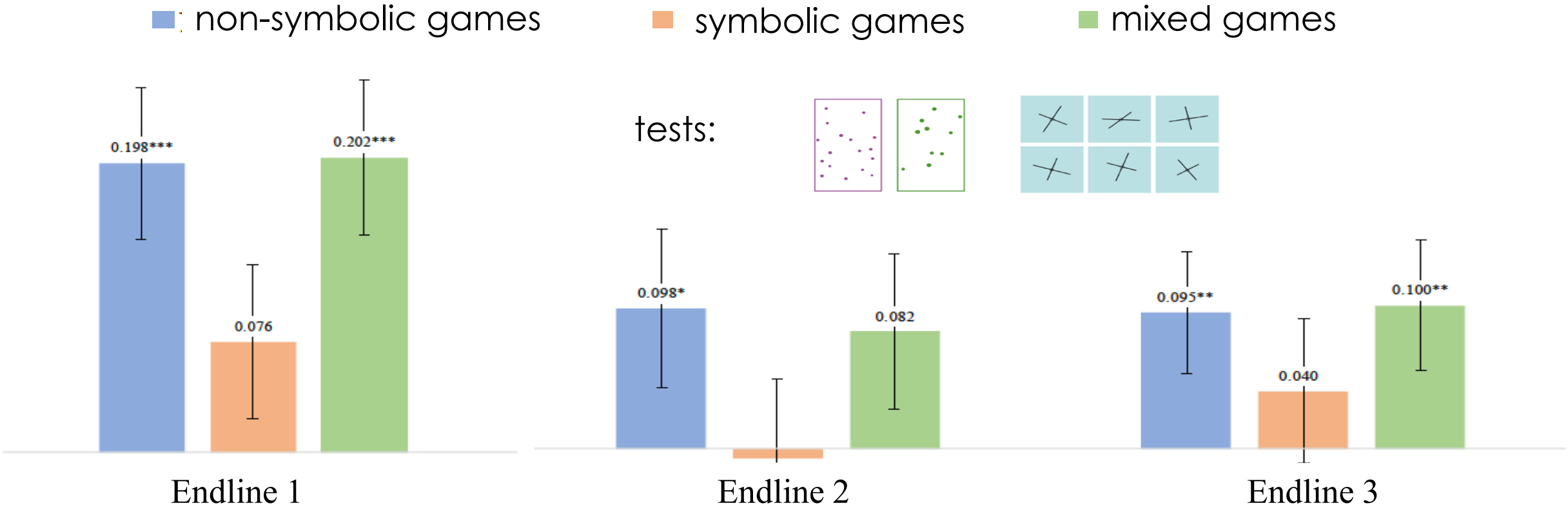








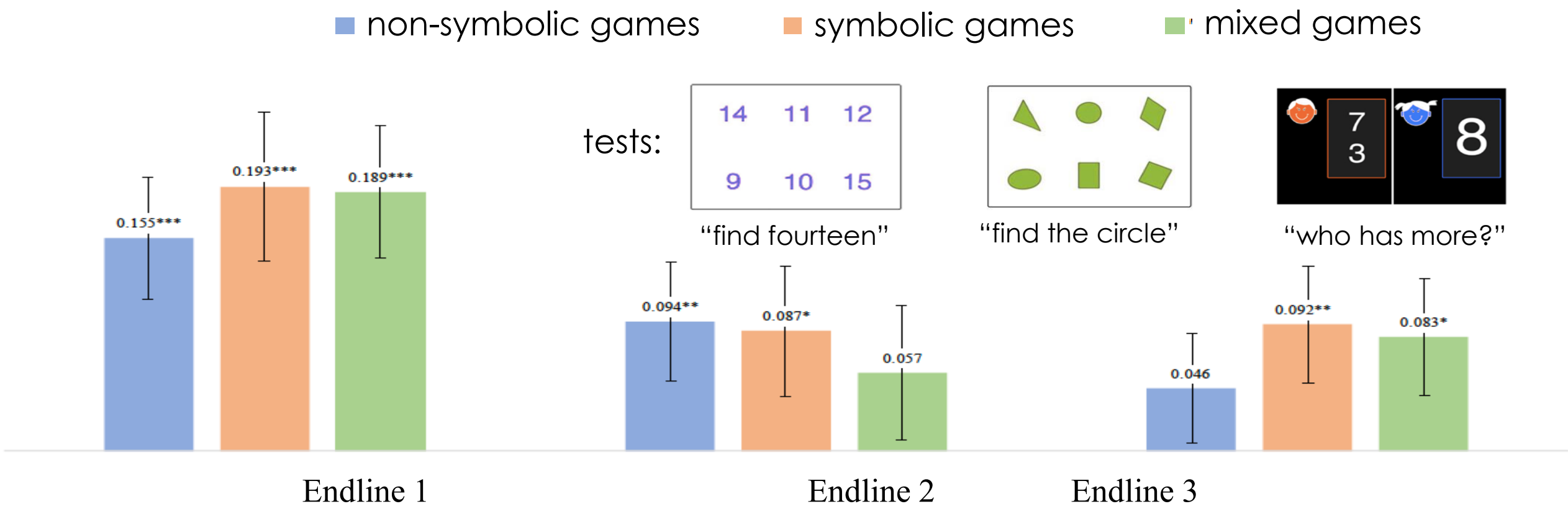
Second expt.: Effects on the non-symbolic measures



The non-symbolic and mixed games increased children's sensitivity to number and geometry in dot arrays and forms. Enduring effects, replicating Exp. 1. Symbolic games had no effect on the intuitive tasks, suggesting the symbols were not given numerical meaning.

NB: Preliminary findings. Z-scores from pre-registered measures and analyses.
Data labeled in black show significant treatment effects relative to no treatment control.
No differences between the 3 treatment conditions are significant. *p<.05, **p<.01, ***p<.001

Second expt.: Effects on the symbolic measures



All 3 conditions enhanced symbolic math abilities at EL1.

The mixed games also enhanced school math learning at the later endlines

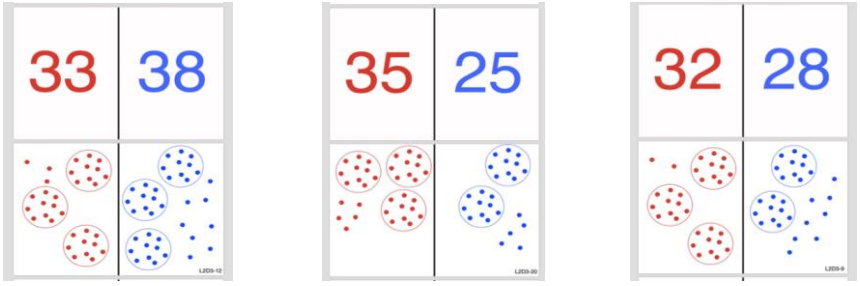
NB: Preliminary findings. Z-scores from pre-registered measures and analyses.
Data labeled in black show significant treatment effects relative to no treatment control.
*p<.05, **p<.01, ***p<.001

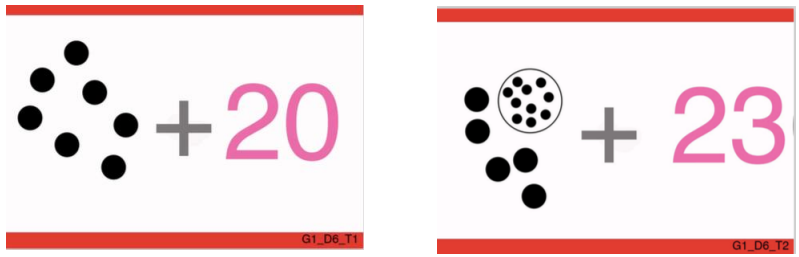
Experiment 3: Scalable model

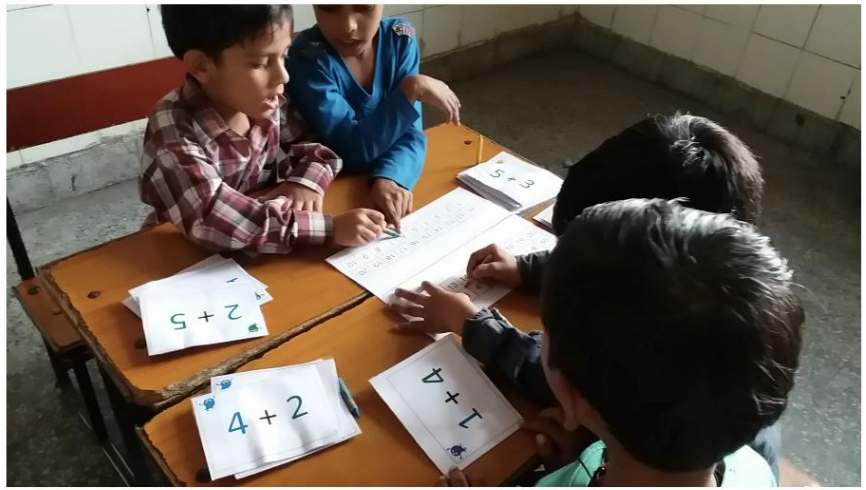
Games for kindergarten and Grade 1 children in 141 government schools (randomized to treatment vs. control).

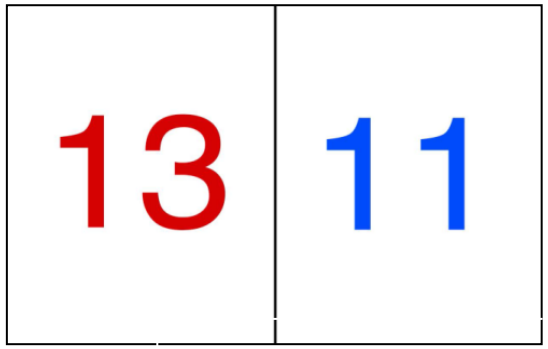
Games are led by regular teachers and played by all children at once, in groups.

Cards emphasize the base-ten structure of the number system and the equivalence of one ten and ten ones.

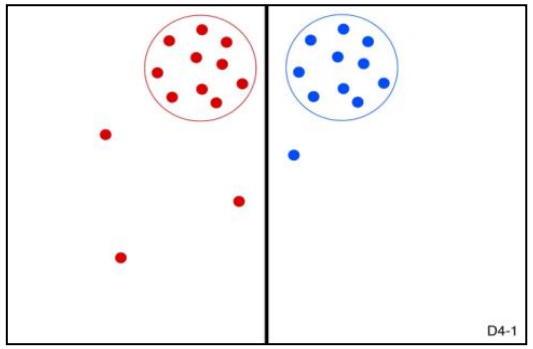






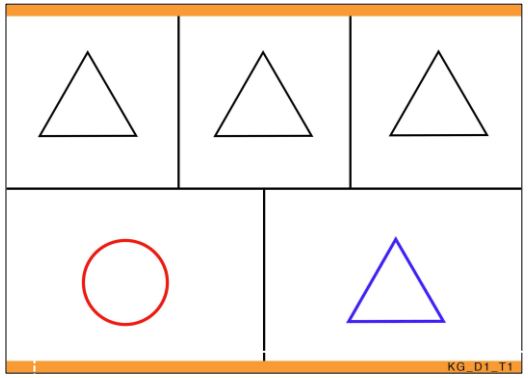


Front

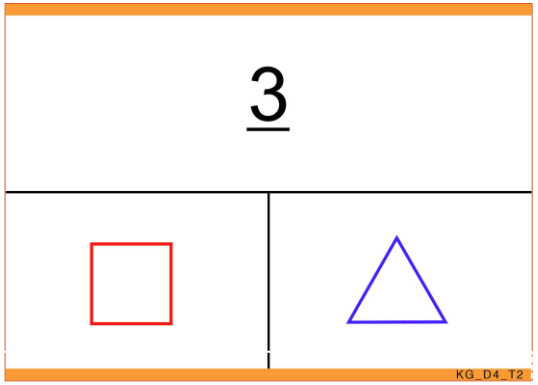


Back

Number Comparison	
G1: Numbers 1-100, Decks go from being 100% double sided to 0 %	KG: Numbers 1-20, Decks go from being 100% double sided to 25 %

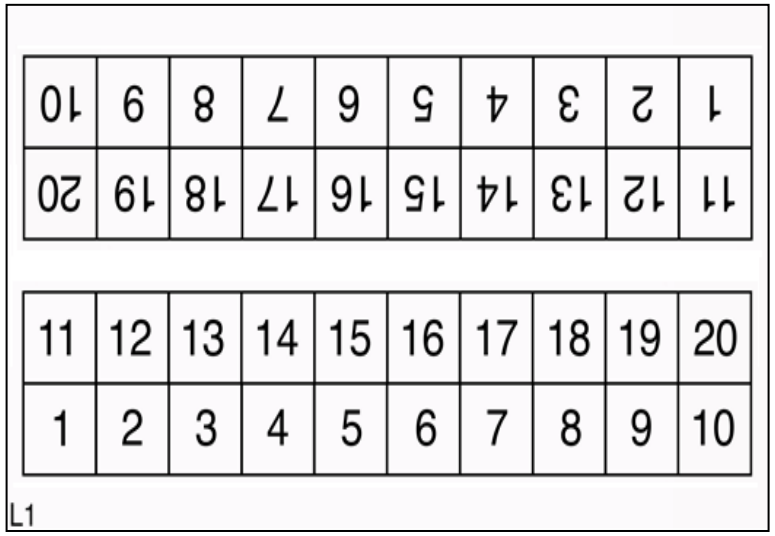


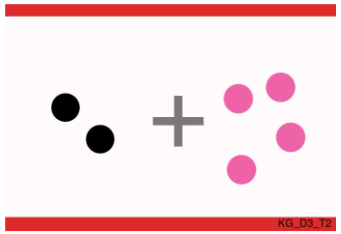
Non-symbolic

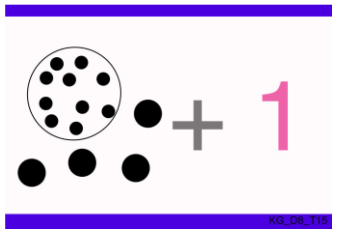


Symbolic

Find shape
Distinguish between dissimilar (3 sided versus 4) and similar shapes (triangles)
Perpendicular & parallel lines, Acute and Obtuse angles, length of sides, symmetry

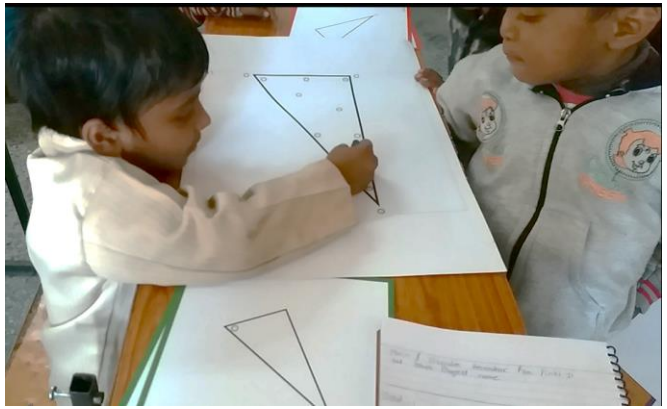


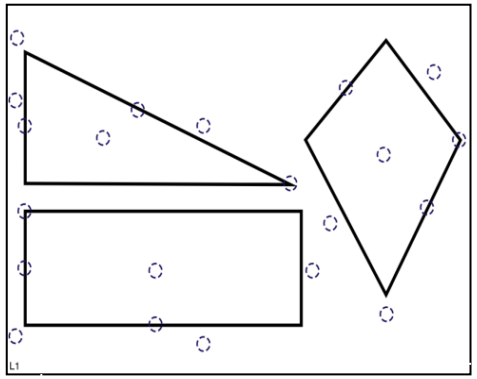




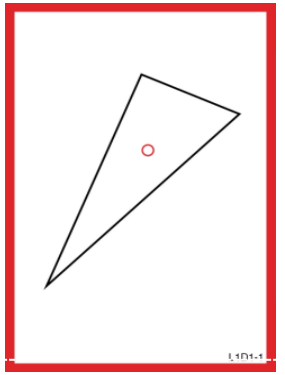
Find and Move

Board number range: 1- 100 (Grade 1), 1- 20 (Kindergarten). Decks use dot arrays and Arabic numbers

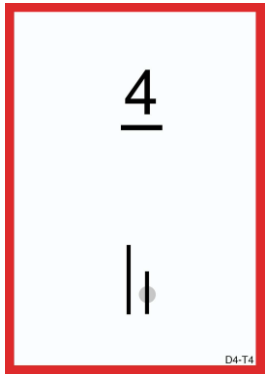




Board



Non-symbolic



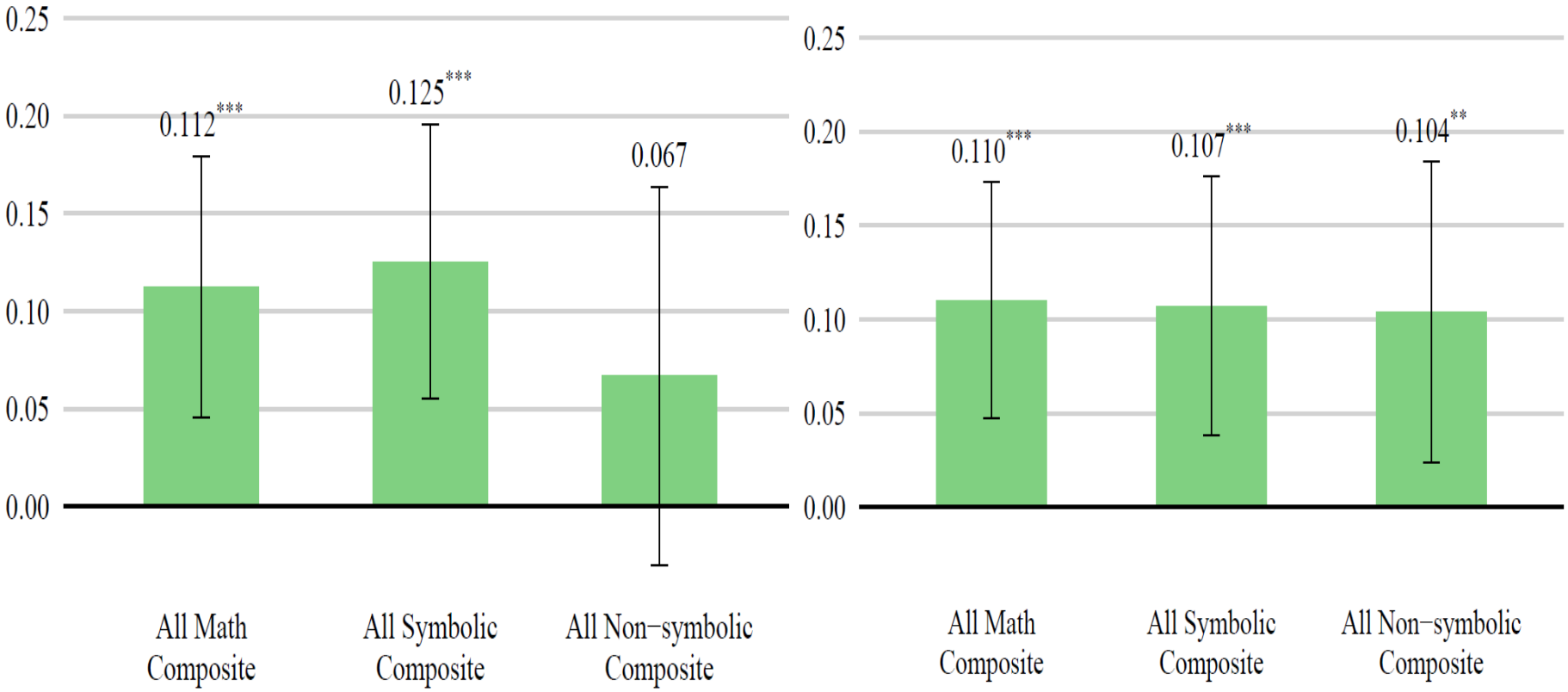
Symbolic

Find and Move

KG Properties: Inside, On the side, Near
Grade 1 Properties: Inside, On the side, Near, Longest Side, Shortest Side, Largest Angle, Smallest Angle

Results

- Math games led to strong impact on symbolic math outcomes for both Kindergarten and Grade 1 students



Fixing primary education

Working on the margins: Some parts of the system are more open

- Tutoring
- Completely defunct schools
- Pre-school
- Early Grade where it may be possible to complement the curriculum
- Summers

The worry is the temptation to close this margin as it expands

- Regulate coaching center
- Set up a curriculum for pre-school

Ready to scale!

- Games were very received by teachers (in contrast to remedial education packages that is hard to get implemented in schools)
- Effects were still larger in classes that played it more.
- Training is easy: one day training + material
- Talking to several State governments with the hope of encouraging scale up
- Hoping to talk to game company to encourage publication of games

Fixing primary education

Patience

- Ultimately there is probably not going to be a silver bullet
- We will need to continue to engage with the school system as it is, however frustrating
- The good thing is that we exactly know what needs to be done
- The challenge is to exploit all existing wedges and pry open new ones at every opportunity.
- There are real gains, and they are multiplied by millions of children.

References

- ASER. Annual Status of Education Report (Rural). Various Reports. http://www.asercentre.org/Keywords/p/393.html
- Angrist, N., Djankov, S., Goldberg, P.K. *et al.* Measuring human capital using global learning data. *Nature* **592,** 403–408 (2021). https://doi.org/10.1038/s41586-021-03323-7
- Abhijit V. Banerjee[a,1], Swati Bhattacharjee[b], Raghabendra Chattopadhyay[c], Esther Duflo[a,], Alejandro J. Ganimian[d], Elizabeth S. Spelke[e] "Street smart or school smart? The arithmetic skills of working children in two Indian cities" MIMEO, MIT
- De Ree, J., Muralidharan, K., Pradhan, M. and Rogers, H., 2018. Double for nothing? Experimental evidence on an unconditional teacher salary increase in Indonesia. The Quarterly Journal of Economics, 133(2), pp.993-1039.
- Banerjee, Abhiit, Rukmini Banerji, James Berry, Esther Duflo Harini Kannan, Shobhini Mukherji, Marc Shotland and Michael Walton "From Proof of Concept to Scalable Policies: Challenges and Solutions, with an Application" Journal of Economic Perspectives, Vol. 31, Number 4, fall 2017
- Duflo, Esther. 2001. "Schooling and Labor Market Consequences of School Construction in Indonesia: Evidence from an Unusual Policy Experiment." *American Economic Review*, 91 (4): 795-813.
- Dillon, M.R., Kannan, H., Dean, J.T., Spelke, E.S. and Duflo, E., 2017. Cognitive science in the field: A preschool intervention durably enhances intuitive but not formal mathematics. Science, 357(6346), pp.47-55.
- Duflo, E., Hanna, R. and Ryan, S.P., 2012. Incentives work: Getting teachers to come to school. American Economic Review, 102(4), pp.1241-78.
- Muralidharan, K. and Sundararaman, V., 2011. Teacher performance pay: Experimental evidence from India. Journal of political Economy, 119(1), pp.39-77.
- Muralidharan, K. and Sundararaman, V., 2015. The aggregate effect of school choice: Evidence from a two-stage experiment in India. The Quarterly Journal of Economics, 130(3), pp.1011-1066.
- Muralidharan, Karthik, and Nishith Prakash. 2017. "Cycling to School: Increasing Secondary School Enrollment for Girls in India." *American Economic Journal: Applied Economics*, 9 (3): 321-50.