Do Performance Targets Affect Behaviour?
Evidence from Discontinuities in Test Scores in England

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The paper

I study the **effect of meeting** an absolute **performance target** in tests **on subsequent behaviour** by

- using a **linked dataset** of students in compulsory education in England with information on

  - **test scores** in English, Maths and Science
  - proxies for **behaviour**: absence from school, bullying, suspension, expulsion and police warning

- exploiting a **local randomised experiment** at discontinuities in test scores to identify the effect

I **find** that meeting a performance target has a **negative but only marginally significant effect on behaviour**, e.g. the probability of unauthorised absence

Students' behaviour by achievement in tests
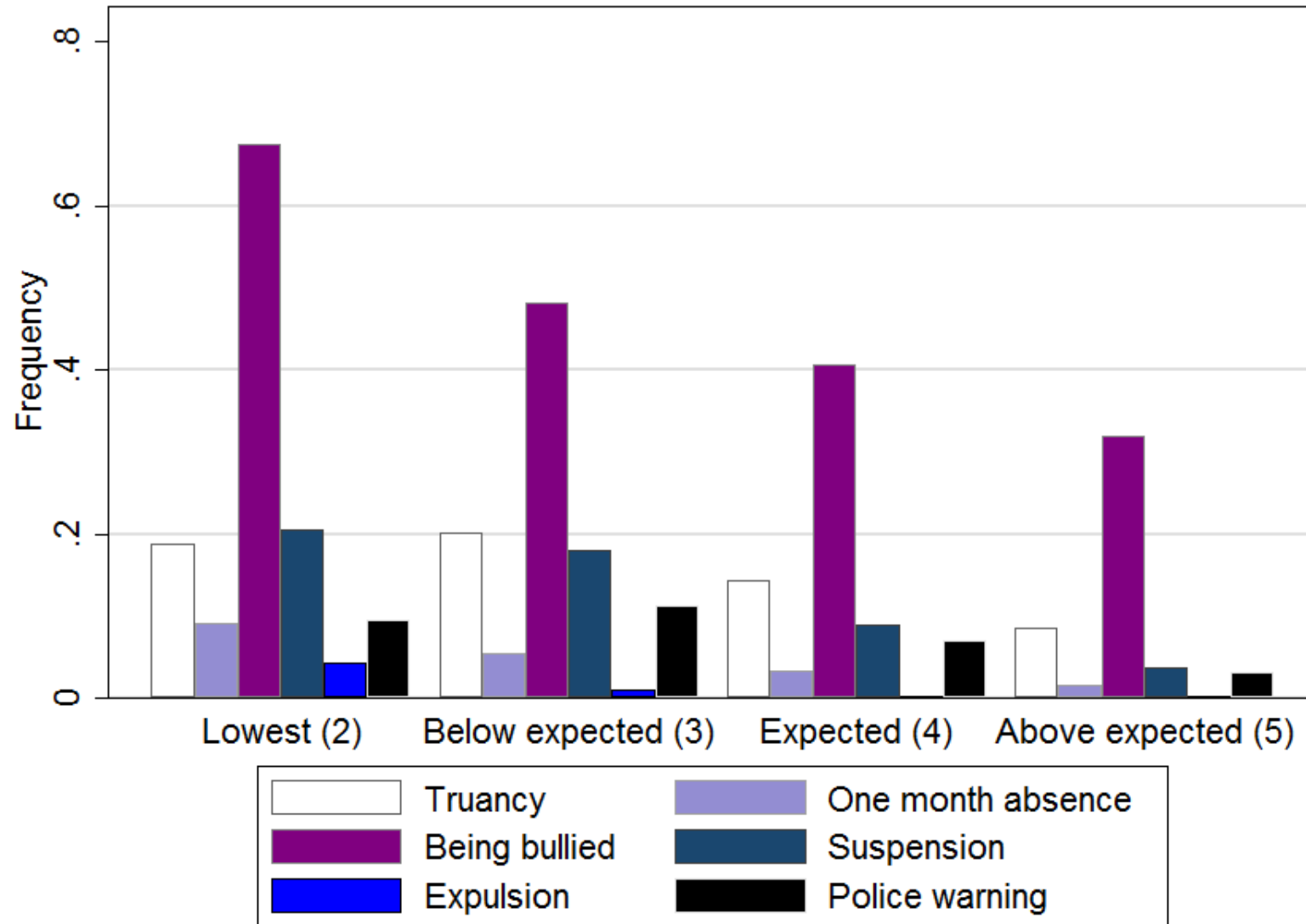
Modest variation in observed behaviour of students scoring below the expected target (3) w.r.t. those at the target (4) in survey data

Broader question

Performance targets help individuals to **build human capital** or **signal ability**

However, targets may have **unintended consequences**

- **change** individuals' **beliefs** about ability
- **induce low effort** by high ability individuals absent pay on performance
- evidence in employment contracts (Prendergast (1999)) but not on, e.g. absence or police warnings

Can one **test of the effect of performance targets on behaviour** to inform

- education policy in England (Every Child Matters) and beyond (No Child Left Behind in the USA)?
- public policy more broadly, e.g. employment contracts, promotions, charity?

Intution of the treatment

In tests at **age 11 students** face **performance targets** that the **Department of Education** set for them

Meeting a target reassures a student that (s)he will succeed in tests in secondary school, as well as parents and schools

Tests are **graded** using a **continuous scale** and **externally**

Tests scores are instead **disclosed** using **categorical values**

- below target (3)
- at or above the **expected target** (4)
- at or above a target for high ability students (5)

The **institutional setting** offers a **local randomised experiment if** students scoring **3.9**, the **control**, versus **4.1**, the **treated** are **identical** in (un)observables

Institutional setting: school curriculum in the UK

(1) Primary/ Secondary	(2) Age	(3) Stage	(4) Year	(5) Assessment	(6) Expected achievement level
	3-4	Early Years Foundation Stage (EYFS)			
	4-5	EYFS	Reception	Tests	6-9/13 elements
Primary School	5-6	Key Stage 1	1		
	6-7		2	Teacher assessments in English, Maths and Science (EMS)	2
	7-8	Key Stage 2	3		
	8-9		4		
	9-10		5		
	10-11		**6**	**National and teacher assessments in EMS**	**4**
Secondary School	**11-12**	**Key Stage 3**	**7**	**Teacher assessments**	
	12-13		**8**	**Teacher assessments**	
	13-14		9	Teacher assessments in EMS and foundation subjects	5 or 6
	14-15	Key Stage 4	10	Some children take GCSEs	
	15-16		11	Most children take GCSEs or other national qualifications	5 A*-C or equivalent including English and Maths

Disclosure of tests results to students

2010 end of key stage 2 pupil results

**Qualifications
and Curriculum
Development
Agency**

Pupil's name		Class	

English		
Teacher assessment results		
Speaking and listening	Level	
Reading	Level	
Writing	Level	
Overall English result	Level	
Test results		
Reading	Level	
Writing	Level	
Overall English result	Level	

Mathematics		
Teacher assessment result	Level	
Test result	Level	

Science		
Teacher assessment result	Level	

Level 3 and below represents achievement below the nationally expected standard for most 11-year-olds. Level 4 represents achievement at the nationally expected standard for most 11-year-olds. Levels 5 and 6 represent achievement above the nationally expected standard for most 11-year-olds.

Students obtain categorical results $\{2,3,4,5\}$ in the grade sheet and targets are written at the bottom

Three scores in tests at Key Stage 2

	KS2 Maths level 3			KS2 Maths level 4			KS2 Maths level 5		
	KS2 Science level 3	KS2 Science level 4	KS2 Science level 5	KS2 Science level 3	KS2 Science level 4	KS2 Science level 5	KS2 Science level 3	KS2 Science level 4	KS2 Science level 5
KS2 English level 3	3.39	6.15	**0.16**	0.46	4.42	0.46	**0.00**	**0.12**	**0.04**
KS2 English level 4	1.07	8.50	**0.33**	0.48	23.66	7.23	**0.01**	3.32	5.71
KS2 English level 5	**0.00**	**0.42**	**0.10**	**0.00**	5.36	5.82	**0.00**	2.17	14.72

I use **test score by subject** and the **mean score in all tests** as students have to meet targets in each test

Using mean score is tenable **under the assumption** that few/no student meets

- high targets in two tests but fails one

- a high target in one tests and fails the other two

Outcomes (LSYPE survey questionnaire)

(1) Variable Name	(2) Question	(3) Time window w.r.t. survey (Years before)	(4) Mean
Truancy	In the last 12 months, have you ever played truant, that is missed school without permission, even if it was only for a half day or a single lesson?	Up to 1 year	0.14
One month absence	Can I check, in the last 12 months, has (name) been off school for a continuous period of 1 month or more, other than for school holidays?	Up to 1 year	0.03
Being bullied	The next question is about any bullying or other bad behaviour from other pupils at (his/her) school that you know have happened to (name) in the last 12 months. Have any of these things happened to (name) at school in the last 12 months? 1. Called names by other pupils at his/her school 2. Sent offensive or hurtful text messages or emails 3. Shut out from groups of other pupils or from joining in things 4. Made to give other pupils his or her money or belongings 5. Threatened by other pupils with being hit or kicked or with other violence 6. Actually being hit or kicked or attacked in any other way by other pupils 7. Any other sort of bullying 8. No, none of these things have happened in the last 12 months	Up to 1 year	0.43
Suspension	Has (name) been temporarily excluded, that is suspended, from a school for a time, in the past 3 years?	Up to 3 years	0.10
Expulsion	Has (name) been permanently excluded, that is expelled from school for good, in the past 3 years?	Up to 3 years	0.01
Police warning	Have the police got in touch with you (or your husband/wife/partner) about (name) because of something he/she had done in the last 3 years? 1. Yes , in last 3 years; 2. No; 3. Not in the last three years	Up to 3 years	0.07

Timing of events and data collection
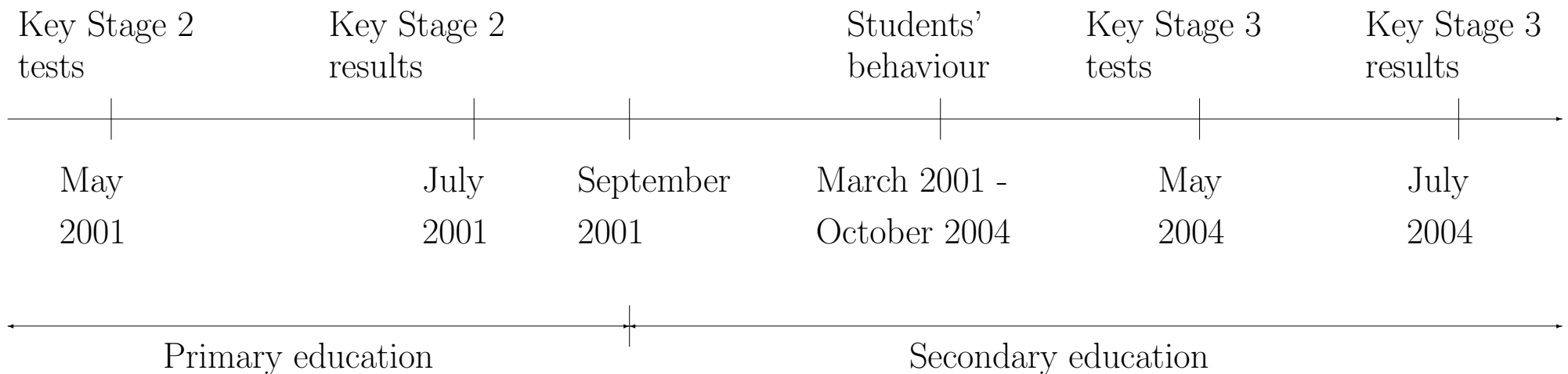
A **cohort of students**

- sit tests in May 2001 and obtain test results in July 2001
- start secondary school in September 2001

Survey data are collected in March-October 2004 on the behaviour of a nationally **representative subsample** of the cohort

Administrative data on students' test scores is **linked to survey data** on their behaviour

Summary statistics: outcome variables

Variable Names	All	Females	Males
Outcome variables			
Truancy	0.14	0.14	0.14
One month absence	0.03	0.03	0.03
Victim of bullying	0.43	0.45	0.39
Suspension	0.10	0.06	0.14
Expulsion	0.01	0.01	0.01
Police warning	0.07	0.05	0.10
Missingness in outcome variables			
Missing: truancy	0.06	0.06	0.06
Missing: one month absence	0.07	0.07	0.06
Missing: bullying victim	0.10	0.09	0.11
Missing: suspension	0.05	0.05	0.05
Missing: expulsion	0.05	0.05	0.05
Missing: police warning	0.06	0.05	0.06
Total n. observations	15770	7727	8043

Summary statistics: covariates

Variable Names	All	Females	Males
Covariates: Key Stage 2 test scores			
Fine grade average test score	4.57	4.58	4.55
S.d.	0.62	0.60	0.64
English fine grade test score	4.44	4.55	4.33
S.d.	0.73	0.68	0.75
Maths fine grade test score	4.45	4.41	4.49
S.d.	0.81	0.78	0.83
Science fine grade test score	4.74	4.73	4.75
S.d.	0.61	0.59	0.62
Covariates: Key Stage 2 school type			
Community school	0.60	0.54	0.67
Voluntary aided school	0.16	0.15	0.18
Voluntary controlled school	0.09	0.08	0.10
Foundation school	0.03	0.03	0.03
Covariates: gender and ethnicity			
Male	0.45	0.00	1.00
Asian	0.06	0.07	0.07
Black	0.03	0.03	0.02
Other	0.05	0.05	0.05
White	0.86	0.85	0.86
Covariates: socio-economic background			
Non-SEN	0.82	0.87	0.77
SEN statement	0.04	0.02	0.05
SEN non-statemented	0.14	0.11	0.18
Free school meals	0.13	0.11	0.14
English additional language	0.18	0.27	0.08
Main parent has a degree	0.13	0.15	0.11
Main parent higher education	0.13	0.13	0.13
Main parent GCSE	0.45	0.44	0.46
Main parent other qualification	0.11	0.10	0.11
Main parent no qualification	0.18	0.18	0.18
Total n. observations	15770	7727	8043

Research design

$$B = \alpha + \beta_{OLS}T + U_1 \tag{1}$$

The **outcome variable** B

- is a binary measure of behaviour

- can be interpreted as the observable proxy of whether a latent variable B^* about the importance of school is smaller than a threshold $\bar{B}^*$ or $B = I\{B^* < \bar{B}^*\}$

The **covariate** T is a continuous measure of test score

β_{OLS} measures the **change in the probability of behaviour**, e.g. a student is truant, **due to a unit increase in test score** T

Research design (cont.d)

$$G_c = I\{T \geq \bar{T}_c\} \tag{2}$$
$$B = f(T) + \beta_{RD} G_c + U_2 \tag{3}$$

A threshold $\bar{T}_c \in \{3, 4, 5\}$ in test score T determines whether a student meets a performance target G_c

β_{RD}

- measures the **change in the probability of behaviour** that **meeting a target w.r.t. not meeting it** leads to

- is **unbiased** as it compares students whose test score is just above the target versus those with a score just below and are otherwise identical

β_{OLS} may capture a **spurious effect** on behaviour of meeting a performance target, e.g. a change in score from 4.5 to 5.5, due to unobserved ability

Estimation of a sharp regression discontinuity design

- Estimate **smooth polynomials** in test scores separately for students to the left and right of a threshold

- Choose the **optimal bandwidth** by using the choice rule in Imbens and Kalyanaraman (2009)

- Use a **window of size 2** and centered around each threshold, e.g. threshold 4 +/- 1

- Carry out **robustness checks** to address major concerns about the validity of the design

  - **Pre-treatment values** confound assignment around a threshold
  - **Manipulation** of test scores around the threshold, e.g. by test examiners

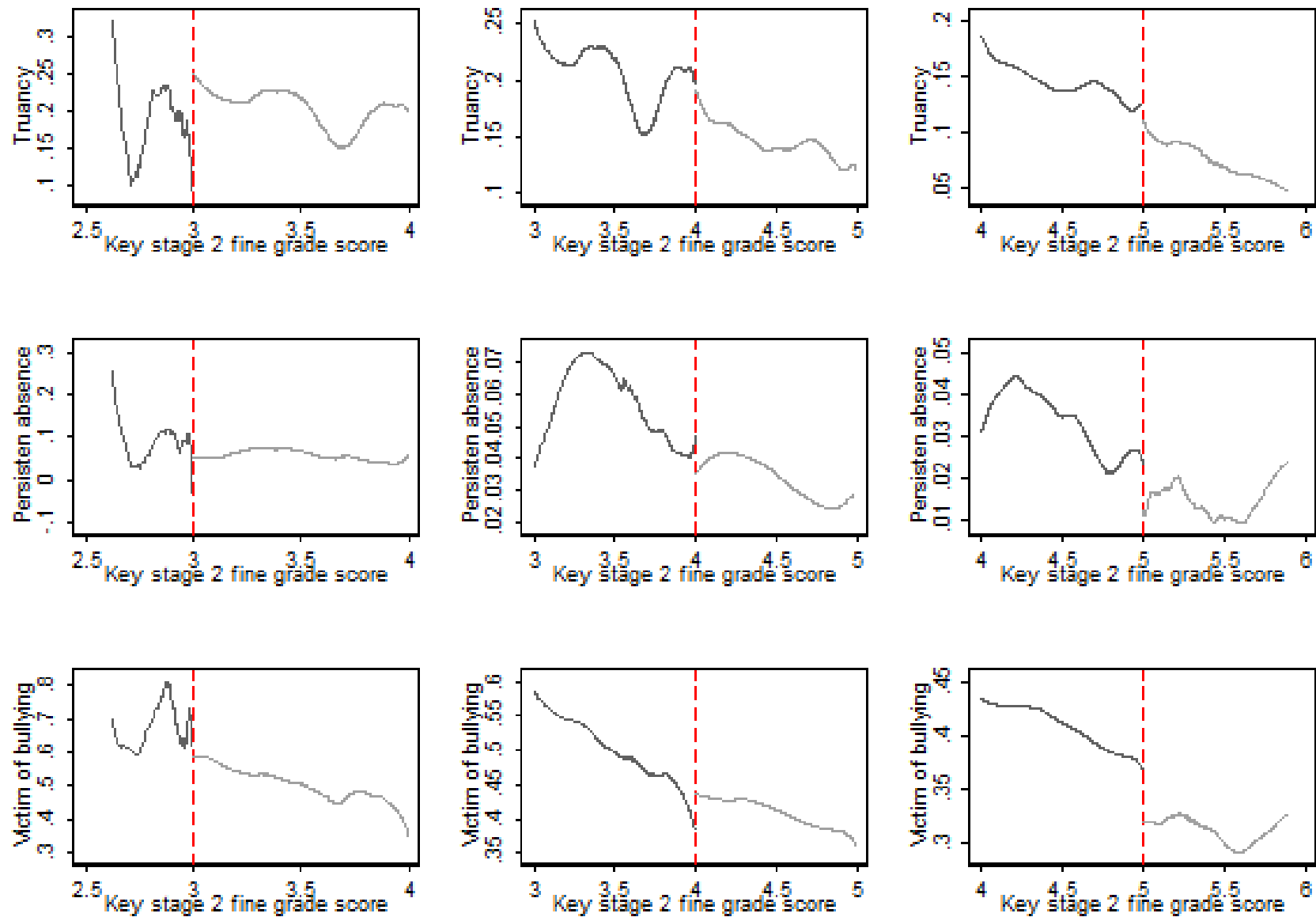# Estimation using a single test score and the average score

Estimates of the effect of meeting a performance target in the English test on behaviour

- imply a ceteris paribus **assumption** about scores in Maths and Science tests

- are **negative but insignificant**

- hardly satisfy the **identifying assumption** that the difference in means of conditional residuals U in the left and right neighbourhood of a threshold is insignificantly different from zero, $\lim_{T\uparrow\bar{T}_c} E[U|T] - \lim_{T\downarrow\bar{T}_c} E[U|T]$

A **solution** to capture the requirement of **meeting** the expected **target** in **all tests**

- is to use the **average test score**

- holds under the **assumption** that variation in scores in triplets of test is negligible for a student

# Regression Discontinuity plots: absence and being bullied

OLS and RD estimates

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
	All sample				Females				Males			
	OLS	RD 2-3	RD 3-4	RD 4-5	OLS	RD 2-3	RD 3-4	RD 4-5	OLS	RD 2-3	RD 3-4	RD 4-5
Truancy	-.03	.08	-.05	-.01	-.03	-.07	-.02	.03	-.03	.12	-.06	-.06
	(.01)***	(.07)	(.04)	(.02)	(.01)***	(.11)	(.04)	(.03)	(.01)***	(.08)	(.04)	(.02)***
Obs.	9858	1729	7119	8128	9858	800	3529	4070	9858	929	3590	4058
One month absence	-.02	-.03	-.004	-.02	-.02	-.02	-.007	-.01	-.02	-.03	.01	-.02
	(.005)***	(.04)	(.01)	(.01)*	(.005)***	(.06)	(.02)	(.02)	(.005)***	(.06)	(.02)	(.01)
Obs.	9540	1634	6837	7905	9540	741	3360	3928	9540	893	3477	3977
Being bullied	-.09	-.15	.04	-.04	-.09	-.26	.06	-.07	-.09	-.12	.01	-.05
	(.02)***	(.08)*	(.03)	(.02)*	(.02)***	(.09)***	(.05)	(.04)*	(.02)***	(.12)	(.05)	(.04)
Obs.	9119	1586	6552	7532	9119	722	3255	3797	9119	864	3297	3735
Suspension	-.03	.006	.03	-.02	-.03	.28	.0004	.01	-.03	-.15	.04	-.05
	(.008)***	(.06)	(.02)	(.02)	(.008)***	(.12)**	(.03)	(.02)	(.008)***	(.10)	(.03)	(.03)
Obs.	9657	1676	6936	7980	9657	759	3424	3982	9657	917	3512	3998
Expulsion	-.0009	-.004	-.0009	.004	-.0009	.03	.006	.005	-.0009	-.01	-.009	.003
	(.0006)	(.04)	(.005)	(.002)*	(.0006)	(.04)	(.004)	(.004)	(.0006)	(.05)	(.009)	(.003)
Obs.	9674	1679	6948	7994	9674	762	3426	3984	9674	917	3522	4010
Police warning	-.03	.10	.02	-.008	-.03	.12	-.02	.005	-.03	.04	.06	-.01
	(.007)***	(.06)	(.02)	(.01)	(.007)***	(.12)	(.03)	(.01)	(.007)***	(.08)	(.03)*	(.02)
Obs.	9615	1666	6898	7948	9615	761	3415	3972	9615	905	3483	3976

- Effects are (not) significant at the expected target in (full sample) sub-samples by gender

- OLS estimates are downward biased with respect to RD ones

# Robustness check: pre-treatment values do not lead to "jumps"

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Achievement cutoff 3			Achievement cutoff 4			Achievement cutoff 5		
	Left	Right	P-value	Left	Right	P-value	Left	Right	P-value
Male	0.59	0.67	0.15	0.49	0.52	0.22	0.45	0.50	0.06
Teacher Assessment Test scores									
English lev. 2	0.46	0.56	0.12	0.03	0.02	0.88	.	.	.
English lev. 3	0.43	0.38	0.73	0.52	0.56	0.16	0.01	0.01	0.42
English lev. 4	0.02	-0.00	0.85	0.41	0.38	0.75	0.55	0.57	0.28
Maths lev. 2	0.31	0.50	0.02	0.01	0.00	0.83	.	.	.
Maths lev. 3	0.60	0.41	0.99	0.60	0.53	0.94	0.00	-0.00	0.88
Maths lev. 4	0.00	-0.00	0.53	0.35	0.42	0.05	0.48	0.56	0.04
Science lev. 2	0.25	0.22	0.67	0.00	-0.00	0.79	.	.	.
Science lev. 3	0.67	0.71	0.35	0.26	0.28	0.37	0.00	-0.00	0.75
Science lev. 4	0.00	0.04	0.10	0.69	0.67	0.66	0.41	0.43	0.27
School type at Key Stage 2									
VA school	0.06	0.11	0.16	0.15	0.14	0.69	0.20	0.24	0.08
VC school	0.10	0.08	0.61	0.09	0.08	0.59	0.09	0.10	0.34
Found.n school	-0.00	0.01	0.15	0.02	0.02	0.62	0.03	0.03	0.26
Ethnicity									
Black	0.05	0.11	0.07	0.10	0.08	0.81	0.06	0.06	0.53
Asian	0.31	0.24	0.80	0.19	0.22	0.15	0.13	0.13	0.53
Other	0.04	0.07	0.30	0.05	0.06	0.20	0.06	0.07	0.23
Socio-economic background									
SEN statement	0.14	0.21	0.11	0.03	0.02	0.77	0.00	0.00	0.22
SEN non-statemented	0.64	0.53	0.92	0.22	0.29	0.02	0.02	0.04	0.04
FSM	0.41	0.44	0.31	0.24	0.26	0.30	0.13	0.13	0.38
EAL	0.35	0.29	0.78	0.23	0.26	0.14	0.16	0.16	0.43
Main parent (MP)									
MP with a degree	0.01	0.02	0.35	0.04	0.06	0.13	0.12	0.18	0.01
MP higher education	0.11	0.02	0.96	0.08	0.11	0.16	0.17	0.15	0.84
MP GCSE	0.23	0.29	0.19	0.43	0.36	0.96	0.49	0.45	0.87
MP other qualification	0.16	0.20	0.26	0.15	0.13	0.81	0.07	0.10	0.07
MP's father with a degree	0.03	0.01	0.68	0.06	0.05	0.75	0.06	0.08	0.15

Robustness check: gaming at thresholds
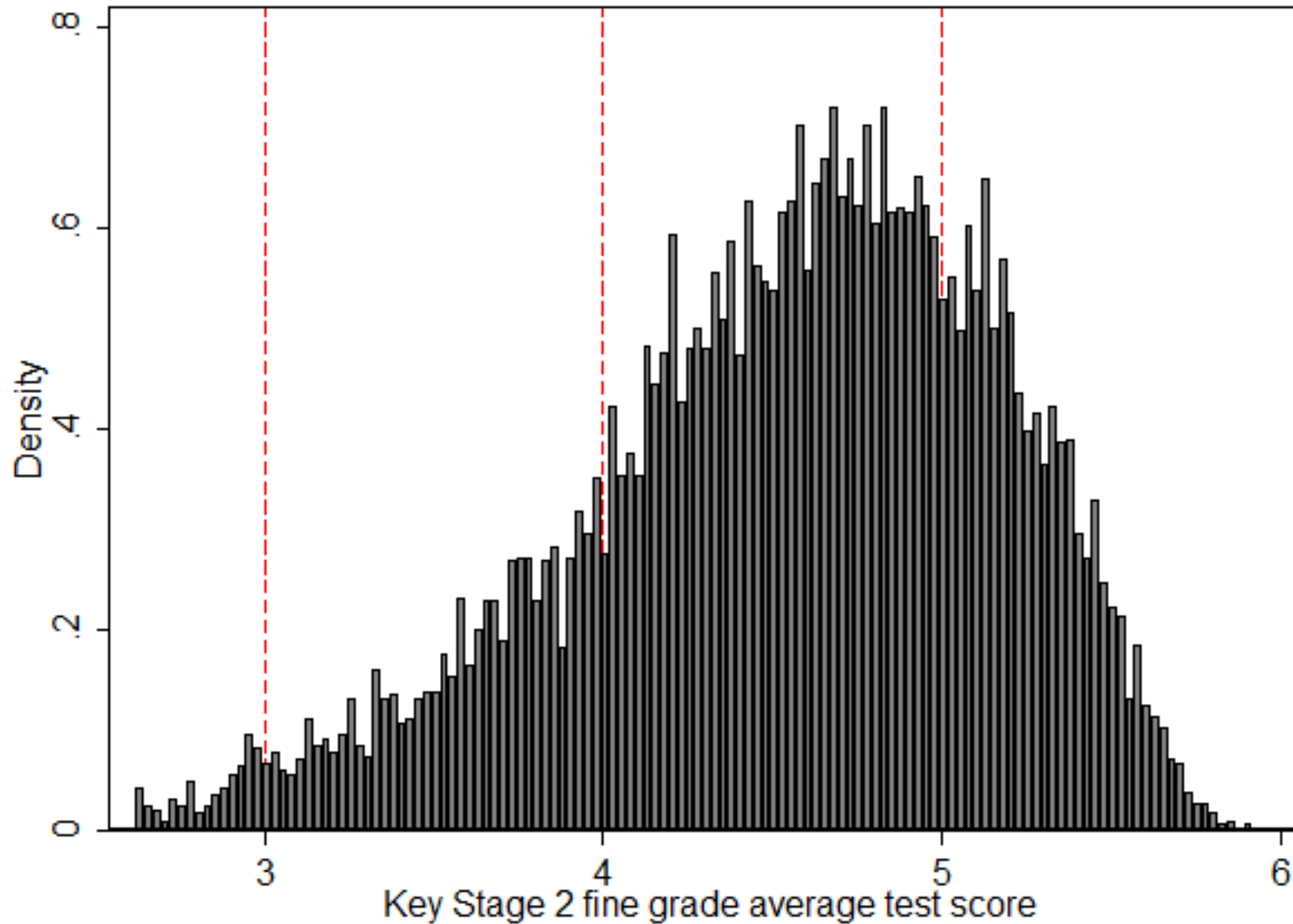
An undersmoothed histogram of the average test score shows no compelling evidence of gaming around thresholds

Robustness check: test for gaming at thresholds (McCrary (2008))
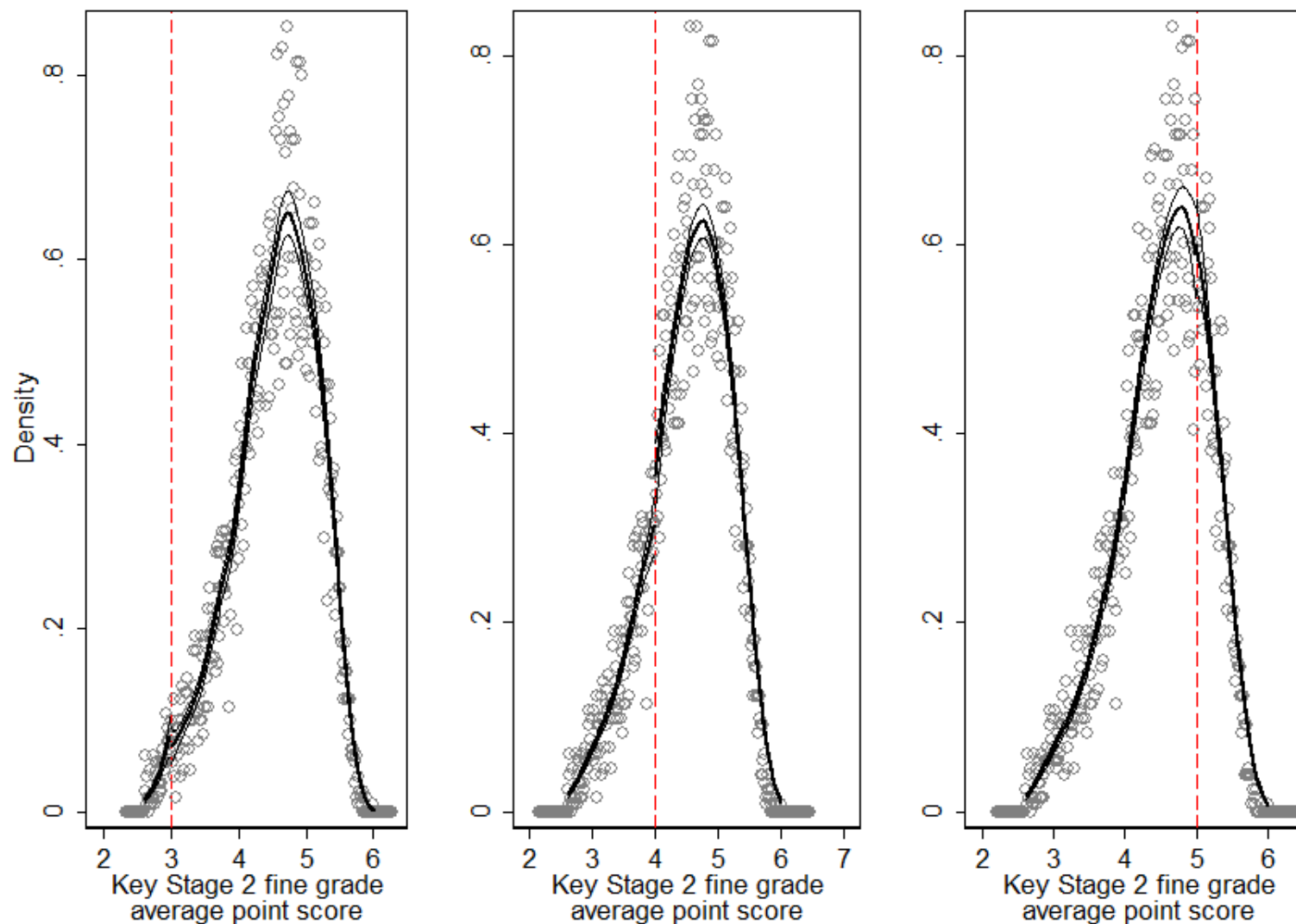
No rejection of the null hypothesis of no gaming around thresholds in McCrary (2008)

Additional robustness check: estimation window

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
		Achievement cutoff 3				Achievement cutoff 4				Achievement cutoff 5		
	2-4	2.05-3.95	2.15-3.85	2.25-3.75	3-5	3.1-4.9	3.3-4.7	3.5-4.5	4-6	4.1-5.9	4.3-5.7	4.5-5.5
Truancy	.08	.09	.08	.08	-.05	-.05	-.04	-.007	-.01	-.005	-.005	-.008
	(.07)	(.08)	(.08)	(.08)	(.04)	(.03)	(.04)	(.05)	(.02)	(.02)	(.02)	(.02)
Obs.	1729	1577	1330	1073	7119	6436	5006	3492	8128	7772	6802	5417
One month absence	-.03	-.04	-.04	-.03	-.004	-.0004	-.01	-.02	-.02	-.02	-.02	-.02
	(.04)	(.04)	(.04)	(.04)	(.01)	(.01)	(.02)	(.02)	(.01)*	(.01)*	(.01)	(.01)*
Obs.	1634	1483	1257	1021	6837	6173	4781	3305	7905	7553	6634	5312
Victim of bullying	-.15	-.14	-.15	-.15	.04	.04	.03	.03	-.04	-.04	-.06	-.04
	(.08)*	(.09)*	(.08)*	(.08)*	(.03)	(.03)	(.04)	(.04)	(.02)*	(.02)*	(.03)*	(.04)
Obs.	1586	1442	1226	998	6552	5921	4594	3181	7532	7196	6325	5044
Suspension	.006	-.02	-.01	.009	.03	.03	.05	.05	-.02	-.02	-.02	-.02
	(.06)	(.07)	(.06)	(.08)	(.02)	(.02)	(.03)*	(.03)*	(.02)	(.02)	(.01)	(.01)
Obs.	1676	1523	1293	1051	6936	6265	4856	3357	7980	7622	6694	5357
Expulsion	-.004	-.006	-.004	-.004	-.0009	-.002	-.001	.0006	.004	.003	.004	.003
	(.04)	(.04)	(.04)	(.04)	(.005)	(.005)	(.006)	(.006)	(.002)*	(.003)	(.003)	(.003)
Obs.	1679	1526	1296	1054	6948	6279	4869	3367	7994	7636	6704	5363
Police warnings	.10	.13	.13	.10	.02	.02	.02	.03	-.008	-.007	-.007	-.006
	(.06)	(.07)*	(.07)*	(.06)	(.02)	(.02)	(.02)	(.03)	(.01)	(.01)	(.01)	(.02)
Obs.	1666	1513	1284	1043	6898	6234	4832	3346	7948	7591	6670	5337

Varying the size of the window that is centered on a threshold varies the number of observations but it does not alter the sign and precision of the RD estimates

Additional robustness check: irrelevant thresholds

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
	Achievement cutoff 3						Achievement cutoff 4						Achievement cutoff 5					
	3	3.1	3.2	3.3	3.4	3.5	4	4.1	4.2	4.3	4.4	4.5	5	5.1	5.2	5.3	5.4	5.5
Truancy	.08	-.11	-.006	.05	-.0008	.006	-.05	.03	.04	-.11	-.008	-.007	-.01	.001	.01	-.001	.002	-.02
	(.07)	(.07)	(.06)	(.06)	(.08)	(.08)	(.04)	(.03)	(.03)	(.03)***	(.02)	(.02)	(.02)	(.02)	(.02)	(.02)	(.03)	(.02)
Obs.	1739	1739	1739	1739	1739	1739	7134	7134	7134	7134	7134	7134	8129	8129	8129	8129	8129	8129
One month absence	-.03	.03	.07	.07	-.03	-.03	-.004	.01	.009	-.004	-.003	-.001	-.02	-.001	.003	-.006	.01	-.02
	(.04)	(.04)	(.04)**	(.04)*	(.04)	(.03)	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)*	(.008)	(.01)	(.008)	(.01)	(.008)**
Obs.	1640	1640	1640	1640	1640	1640	6850	6850	6850	6850	6850	6850	7906	7906	7906	7906	7906	7906
Victim of bullying	-.15	.12	-.14	.14	.03	.006	.04	.07	.03	.003	.02	.006	-.04	.02	.03	-.02	-.01	-.09
	(.08)*	(.09)	(.07)*	(.07)*	(.07)	(.08)	(.03)	(.03)**	(.03)	(.03)	(.03)	(.04)	(.02)*	(.03)	(.04)	(.04)	(.04)	(.05)*
Obs.	1592	1592	1592	1592	1592	1592	6564	6564	6564	6564	6564	6564	7533	7533	7533	7533	7533	7533
Suspension	.001	.009	.01	.08	-.01	-.002	.03	.03	-.03	-.005	.02	.004	-.02	-.006	.02	.005	-.05	-.005
	(.06)	(.07)	(.07)	(.06)	(.06)	(.06)	(.02)	(.02)	(.02)	(.02)	(.02)	(.02)	(.02)	(.01)	(.02)	(.01)	(.02)***	(.02)
Obs.	1682	1682	1682	1682	1682	1682	6949	6949	6949	6949	6949	6949	7981	7981	7981	7981	7981	7981
Expulsion	-.004	.03	.01	.0009	.03	.01	-.0009	-.006	-.0001	-.003	.001	.004	.005	-.0008				
	(.04)	(.04)	(.02)	(.02)	(.01)*	(.01)	(.005)	(.005)	(.004)	(.005)	(.004)	(.002)*	(.004)	(.003)				
Obs.	1685	1685	1685	1685	1685	1685	6961	6961	6961	6961	6961	7995	7995	7995				
Police warning	.10	-.09	.08	.06	.03	-.06	.02	-.02	-.007	.003	-.009	.008	-.008	.002	.009	.02	-.04	-.007
	(.06)	(.07)	(.04)*	(.04)	(.05)	(.04)	(.02)	(.02)	(.02)	(.02)	(.02)	(.02)	(.01)	(.01)	(.01)	(.02)	(.01)***	(.008)
Obs.	1672	1672	1672	1672	1672	1672	6911	6911	6911	6911	6911	6911	7949	7949	7949	7949	7949	7949

Estimating the effect of targets by using irrelevant thresholds, e.g. 4.1 instead of 4, leads to very few significant RD estimates

Discussion

The research design and the institutional setting offer a **valuable test** to

- assess behavioural effects of performance targets

- **inform education and public policies** in the future (Urquiola and Verhoogen (2009)) in the UK and abroad

- **little significant estimates** are **reassuring** evidence for education policies in the UK

Heterogeneity in the estimates by ability, gender, type of outcome and parents' education suggest **nature-nurture tradeoff** (Lizzeri and Siniscalchi (2008)). The effects

- are greater for implicit targets than for the expected target

- on the probability of police warning are greater for males than for females and viceversa for other outcomes

- are greater for students whose parents have a low education level

Contribution to the literature and policy debate

Mixed evidence on behavioural effects of characteristics of the institutional setting in education (Reback (2010), Gaviria and Raphael (2001) and Dee (2004))

Positive **non-market returns to education** in adulthood (Grossman (2006) and Oreopoulos and Salvanes (2009))

Effect of **achievement** in education **today on achievement tomorrow** (Azmat and Iriberri (2009) and Bandiera *et al.* (2009))

Considerable **investment by policy-makers** in studying the determinants of
- achievement gaps and consequences in adulthood, e.g. No Child Left Behind (USA)
- well-being in young age and aulthood, e.g. Every Child Matters (UK)

Future work

- Study the relationship among motivation, effort and achievement (De Fraja *et al.* (2010))

- Study the effect of achievement on behaviour in secondary school and on college choices and outcomes

- Set up a statistical design to inform policy decisions on the effect of X on Y and of Y on X by exploiting linked data

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