School Choice with Consent: An Experiment

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Matching Problems

Schools

Daycare

Matching Problems

Schools

Daycare

How can admissions procedures (matching mechanisms)...

- ...maximize assignments to preferred schools and
- ...minimize violations of the admissions criteria at the same time?

Challenge

Objective 1: Make students better off

- **Pareto-efficiency**
- Assign students to their most preferred schools
- No alternative assignment that can improve at least one student's assignment without making any other student worse off

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Objective 2: Minimize violations of the admissions criteria

- **Stability**
- Assign students in a way that eliminates priority violations
- No student prefers another school (e.g. B) over the school she is currently assigned to (e.g. A) and student has no higher priority at B than others

Problem: Efficiency-stability trade-off

This Paper

What we do

- Build on a mechanism designed to mitigate the efficiency-stability trade-off
- Test the mechanism (EADAM) in an online experiment
- Use insights from behavioral economics to improve the mechanism

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What we show

- EADAM makes students better off without violating the admissions criteria
- More truth-telling under EADAM than under DA
- A small effect of default rules on matching outcomes

Foundation: Deferred Acceptance Algorithm (DA)

Strategy-proofness ☑

- Incentive to rank schools truthfully (procedural fairness)

Stability ☑

- No priority violations (distributive fairness)

Efficiency ☒

- Students could improve their matching by trading slots

Option 1: Post-DA Trading?

Efficiency ☑

- Coasian trading improves assignments for students

Stability ☒

- Amsterdam Court of Appeal, 2015: "If swapping were allowed, (...) it could lead to a student with a [lower priority] bypassing a student with a [higher priority]. Under these conditions, equal opportunities are no longer guaranteed."

Strategy-proofness ☒

- Amsterdam Court of Appeal, 2015: "If students know that swapping is allowed after the placement is made, it would be optimal for them to place popular schools (not necessarily their own preferences) high on their preferred list. (...) [T]hat slot can be used in a trade."

Option 2: EADAM!

Efficiency-adjusted DA mechanism (EADAM)

- Designed to mitigate the efficiency-stability trade-off
- We experimentally test EADAM and explore potential improvements

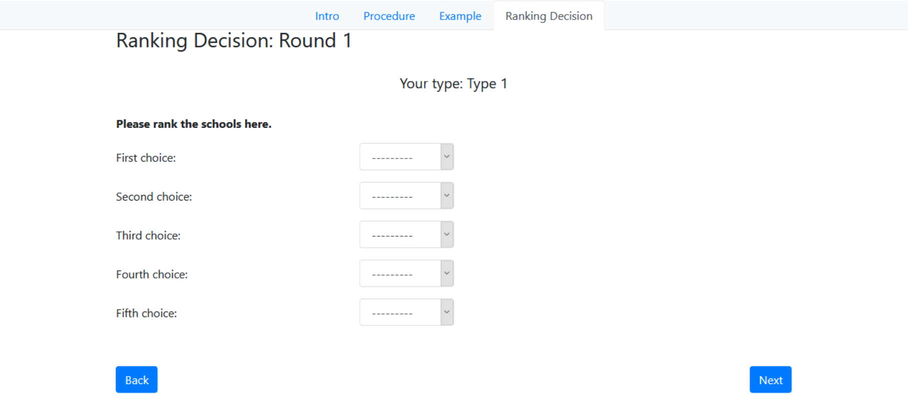
Idea: Increase efficiency of stable matching produced by DA

- Students can consent to waiving priorities that do not affect their placement
- Consent does not harm consenting students but may help others
- Downside: Strategy-proofness ☒, but not obviously manipulable

Efficiency gains increase with

- Consent rates → more waivers are better
- Truthful preference rankings (less gaming is better)

Experimental Design



- Incentivized online experiment
- 5 students and 5 schools with a capacity of one seat respectively
- Participants submit preference rankings over schools

Experimental Design

(Treatment 1) **DA**

(Treatment 2) **EADAM Consent**

- **Priority waiver is non-automatic** (no consent by default)
- Students can consent to the waiver → "liberty"

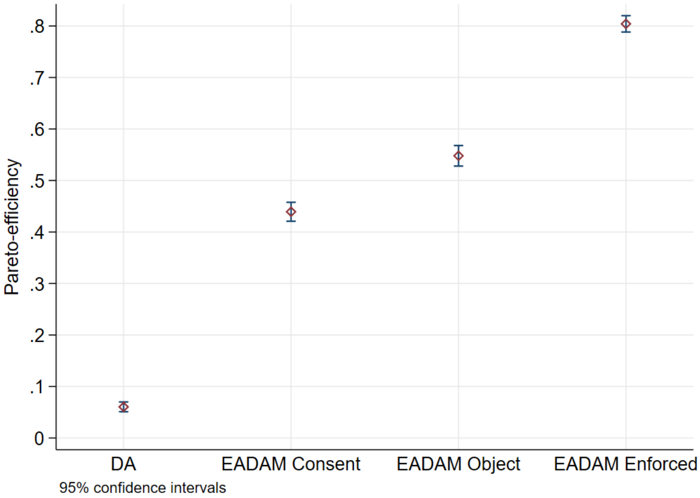
(Treatment 3) **EADAM Object**

- **Priority waiver is automatic** (consent by default)
- Students can object to the waiver → "nudge"

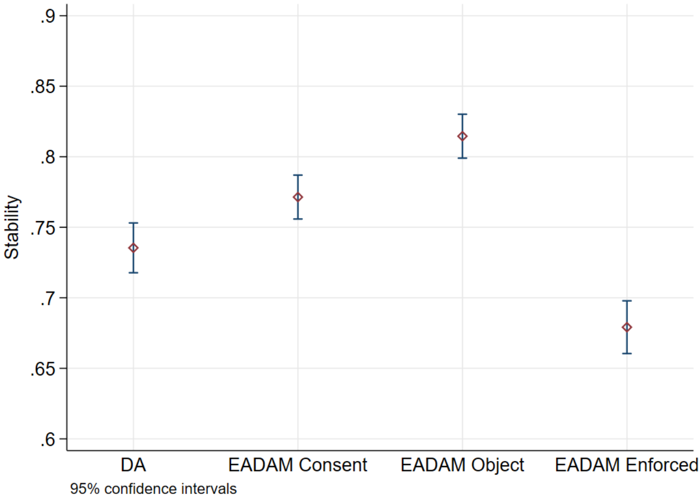
(Treatment 4) **EADAM Enforced**

- **Priority waiver is enforced**
- Students cannot dodge the waiver → "hard intervention"

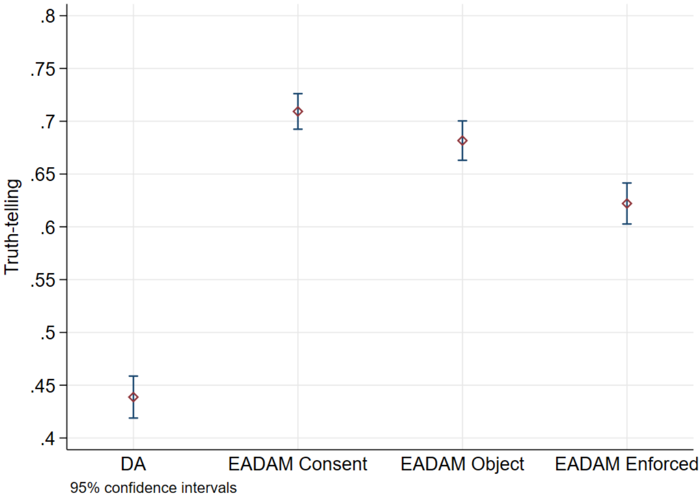
Results: Efficiency



Results: Stability



Results: Truth-telling



Conclusion

Improve assignments while fully respecting the admissions criteria

- Possible to mitigate the efficiency-stability trade-off through EADAM
- EADAM Object seems to combine the best properties

Reduce indirect discrimination

- Less manipulation under EADAM than under DA
- Not obviously manipulable is better than strategy-proof

Policy implications

- Strategy-proofness may be much less of a normative concern
- Mechanism could help vulnerable populations

Not every student can be admitted at Hogwarts. But we can increase the chances of being admitted there and respect the priorities of wizard schools.

Appendix

Solution 1: Deferred Acceptance Algorithm (DA)

Step 1

- Students apply to their **first choice** school.
- Schools **tentatively** admit applicants with highest priority and reject others.

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Step 2

- Students rejected in Step 1 apply to their **next choice** school.
- Schools **tentatively** admit applicants with highest priority, among new applicants and applicants on hold, and reject others.

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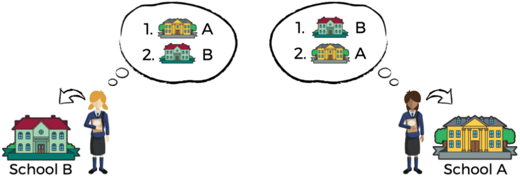
Step k

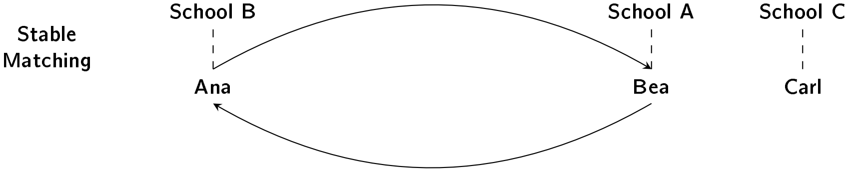
- And so on.

End

- Algorithm terminates when no more rejections are issued.

Solution 2: Trading Slots





Problem

- Trade → generates a Pareto-improvement (Coase)
- But suppose Carl has a higher priority at School B than Bea
- Trade → violates Carl's priority at School B

Solution 3: EADAM

Art. 253/16 § 2 of the Flemish Decree on the Right of Enrollment

Students are assigned a place on the basis of a standard algorithm made available by the Flemish Government, based on the following principles: (...)

b) a student who is favorably ranked for several schools or places of establishment is assigned to the highest school of preference and is removed from the schools of lower choice ⇒ **waiver**

c) after the final assignment, there can be no student who have each other's higher choice ⇒ **efficient**

d) after the final ranking (...), there can be no students with a higher priority at each other's higher choice school ⇒ **stable**

Research Questions

1. **Does EADAM increase efficiency relative to DA?**

2. **How can consent rates under EADAM be increased?**

3. **What is the impact of EADAM on truth-telling?**

EADAM

Step	s_1	s_2	s_3	s_4	s_5
1	i_1	i_2	$\boxed{i_4}$, i_5	i_3	
2	i_1	$\boxed{i_2}$, i_5	i_4	i_3	
3	$\boxed{i_1}$, i_5	i_2	i_4	i_3	
4	i_1	i_2	i_4	$\boxed{i_5}$, i_3	
5	$\boxed{i_1}$, i_3	i_2	i_4	i_5	
6	i_1	$\boxed{i_2}$, i_3	i_4	i_5	
7	i_1	i_2	$\boxed{i_3}$, i_4	i_5	
8	$\boxed{i_4}$, i_1	i_2	i_3	i_5	
9	i_4	i_2	$\boxed{i_3}$, i_1	i_5	
10	i_4	i_2	i_3	$\boxed{i_5}$, i_1	
11	i_4	$\boxed{i_1}$, i_2	i_3	i_5	
12	i_4	i_1	i_3	$\boxed{i_5}$, i_2	
13	$\boxed{i_2}$, i_4	i_1	i_3	i_5	
14	i_2	$\boxed{i_4}$, i_1	i_3	i_5	

EADAM

Step	s_1	s_2	s_3	s_4	s_5
1		i_2	$\boxed{i_4}, i_1, i_5$	i_3	
2		$\boxed{i_2}, i_5$	i_4	$\boxed{i_3}, i_1$	
3	i_5	i_2	i_4	i_3	i_1

If i_1 does not consent, we identify the next interruption: (i_4, s_1). If i_4 consents,

schools s_1 and s_3 are removed from her preference list. Re-running DA produces a Pareto-superior matching, as shown below. Two students (i_3, i_5) are assigned to their top choice, two students (i_2, i_4) to their third choice, one student (i_1) is assigned to her last choice.

EADAM

Step	s_1	s_2	s_3	s_4	s_5
1	i_1	$\boxed{i_4}, i_2$	i_5	i_3	
2	i_1	i_4	i_5	$\boxed{i_3}, i_2$	
3	$\boxed{i_2}, i_1$	i_4	i_5	i_3	
4	i_2	i_4	$\boxed{i_5}, i_1$	i_3	
5	i_2	i_4	i_5	$\boxed{i_3}, i_1$	
6	i_2	$\boxed{i_4}, i_1$	i_5	i_3	
7	i_2	i_4	i_5	i_3	i_1

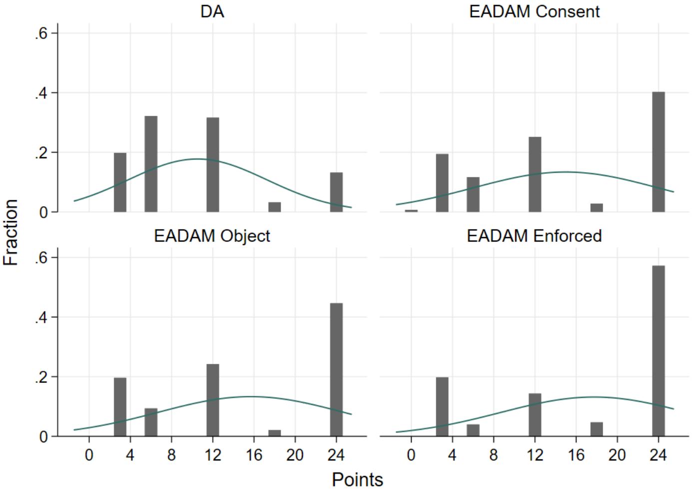
If neither i_1 nor i_4 consents, we identify the next interruption: (i_2, s_2). If i_2

consents, schools s_2 is removed from her preference list. Re-running DA produces a Pareto-inefficient matching that is equivalent to the DA matching. No student is assigned to her top choice.

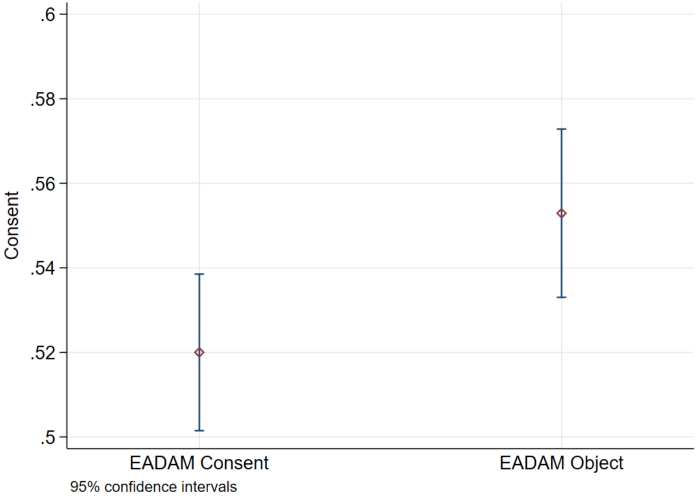
EADAM

Step	s_1	s_2	s_3	s_4	s_5
1	i_1		$\boxed{i_4}$, i_5	$\boxed{i_3}$, i_2	
2	$\boxed{i_2}$, i_1	i_5	i_4	i_3	
3	i_2	i_5	$\boxed{i_4}$, i_1	i_3	
4	i_2	i_5	i_4	$\boxed{i_3}$, i_1	
5	i_2	$\boxed{i_1}$, i_5	i_4	i_3	
6	$\boxed{i_2}$, i_5	i_1	i_4	i_3	
7	i_2	i_1	i_4	$\boxed{i_5}$, i_3	
8	$\boxed{i_2}$, i_3	i_1	i_4	i_5	
9	i_2	$\boxed{i_1}$, i_3	i_4	i_5	
10	i_2	i_1	$\boxed{i_3}$, i_4	i_5	
11	$\boxed{i_2}$, i_4	i_1	i_3	i_5	
12	i_2	$\boxed{i_4}$, i_1	i_3	i_5	
13	i_2	i_4	i_3	i_5	i_1

Results: Inequality



Results: Consent



Results: Efficiency

Table: Impact of EADAM on efficiency compared to DA (binary measure)

DV: Efficiency Baseline: DA	(1)	(2)	(3)	(4)
EADAM Consent	0.374***	0.374***	0.374***	0.366***
	(0.044)	(0.044)	(0.044)	(0.044)
EADAM Object	0.487***	0.487***	0.487***	0.481***
	(0.048)	(0.048)	(0.048)	(0.048)
EADAM Enforced	0.739***	0.739***	0.739***	0.737***
	(0.034)	(0.034)	(0.034)	(0.034)
Type		Yes	Yes	Yes
Round			Yes	Yes
Truth-telling				0.041***
				(0.010)
Wald test	41.86***	41.86***	41.88***	43.58***
N_I	10.000	10.000	10.000	10.000
N_G	50	50	50	50

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Three-level mixed-effects logit regression. Standard errors in parentheses. All coefficients are reported as average marginal effects. *Efficiency* is a dummy variable that takes value 1 if assignments are Pareto-efficient and 0 otherwise. N_I denotes the number of individual observations. N_G denotes the number of experimental matching groups.

Results: Efficiency

Table: Efficiency comparison between EADAM variants (binary measure)

DV: Efficiency	Object vs. Consent			Enforced vs. Object		
Baseline:	EADAM Consent			EADAM Object		
	(1)			(2)		
EADAM Object	0.113*	0.113*	0.113*			
	(0.063)	(0.063)	(0.063)			
EADAM Enforced				0.252***	0.252***	0.252***
				(0.056)	(0.056)	(0.056)
Type		Yes	Yes		Yes	Yes
Round			Yes			Yes
N_I	10.000	10.000	10.000	10.000	10.000	10.000
N_G	50	50	50	50	50	50

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Three-level mixed-effects logit regression. Standard errors in parentheses. *Efficiency* is a dummy variable that takes value 1 if assignments are Pareto-efficient and 0 otherwise. N_I denotes the number of individual observations. N_G denotes the number of experimental matching groups. Column 1: All coefficients are reported as average marginal effects at DA and EADAM Enforced = 0. Column 2: All coefficients are reported as average marginal effects at DA and EADAM Consent = 0.

Results: Stability

Table: Impact of EADAM on stability compared to DA

DV: Stability Baseline: DA	(1)	(2)	(3)	(4)
EADAM Consent	0.045	0.045	0.044	0.013
	(0.044)	(0.044)	(0.044)	(0.042)
EADAM Object	0.076*	0.076*	0.076*	0.049
	(0.044)	(0.044)	(0.044)	(0.042)
EADAM Enforced	-0.045	-0.045	-0.045	-0.067
	(0.050)	(0.050)	(0.050)	(0.048)
Type		Yes	Yes	Yes
Round			Yes	Yes
Truth-telling				0.114***
				(0.011)
Wald test	7.38**	7.38**	7.39**	6.91**
N_I	10.000	10.000	10.000	10.000
N_G	50	50	50	50

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Three-level mixed-effects logit regression. Standard errors in parentheses. All coefficients are reported as average marginal effects. *Stability* is a dummy variable that takes value 1 if assignments are stable and 0 otherwise. N_I denotes the number of individual observations. N_G denotes the number of experimental matching groups.

Results: Stability

Table: Stability comparison between EADAM variants

DV: Stability	Object vs. Consent				Enforced vs. Object			
Baseline:	EADAM Consent				EADAM Object			
	(1)				(2)			
EADAM Object	0.032	0.032	0.032	0.036				
	(0.040)	(0.040)	(0.040)	(0.039)				
EADAM Enforced					-0.121***	-0.121***	-0.121***	-0.116**
					(0.046)	(0.046)	(0.046)	(0.045)
Type		Yes	Yes	Yes		Yes	Yes	Yes
Round			Yes	Yes			Yes	Yes
Truth-telling				0.108***				0.107***
				(0.012)				(0.012)
N_I	10.000	10.000	10.000	10.000	10.000	10.000	10.000	10.000
N_G	50	50	50	50	50	50	50	50

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Three-level mixed-effects logit regression. Standard errors in parentheses. *Stability* is a dummy variable that takes value 1 if assignments are stable and 0 otherwise. N_I denotes the number of individual observations. N_G denotes the number of experimental matching groups. Column 1: All coefficients are reported as average marginal effects at DA and EADAM Enforced = 0. Column 2: All coefficients are reported as average marginal effects at DA and EADAM Consent = 0.

Results: Truth-telling

Table: Impact of EADAM on truth-telling compared to DA

DV: Truth-telling Baseline: DA	(1)	(2)	(3)
EADAM Consent	0.253***	0.246***	0.246***
	(0.039)	(0.033)	(0.033)
EADAM Object	0.246***	0.235***	0.235***
	(0.040)	(0.034)	(0.034)
EADAM Enforced	0.183***	0.177***	0.177***
	(0.041)	(0.035)	(0.035)
Type		Yes	Yes
Round			Yes
Wald test	5.19*	5.45*	5.46*
N_I	10.000	10.000	10.000
N_G	50	50	50

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Three-level mixed-effects logit regression. Standard errors in parentheses. All coefficients are reported as average marginal effects. *Truth-telling* is a dummy variable that takes value 1 if students report their preferences truthfully and 0 otherwise. N_I denotes the number of individual observations. N_G denotes the number of experimental matching groups.

Results: Truth-telling

Table: Truth-telling comparison between EADAM variants

DV: Truth-telling	Object – Consent			Enforced – Object		
Baseline:	EADAM Consent			EADAM Object		
	(1)			(2)		
EADAM Object	-0.007	-0.011	-0.011			
	(0.031)	(0.030)	(0.030)			
EADAM Enforced				-0.063*	-0.058*	-0.058*
				(0.035)	(0.033)	(0.033)
Type		Yes	Yes		Yes	Yes
Round			Yes			Yes
N_I	10.000	10.000	10.000	10.000	10.000	10.000
N_G	50	50	50	50	50	50

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