College Admissions with Entrance Exams: Centralized versus Decentralized

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一帝制曰道光二十七年四月二十一日策試天下貢士許彭壽

等二百三十一名第一甲賜進士及第第第二甲賜進士出身

第三甲賜同進士出身故茲誥示

第一甲賜進士及第

第一名張之萬　　直隸南皮縣人
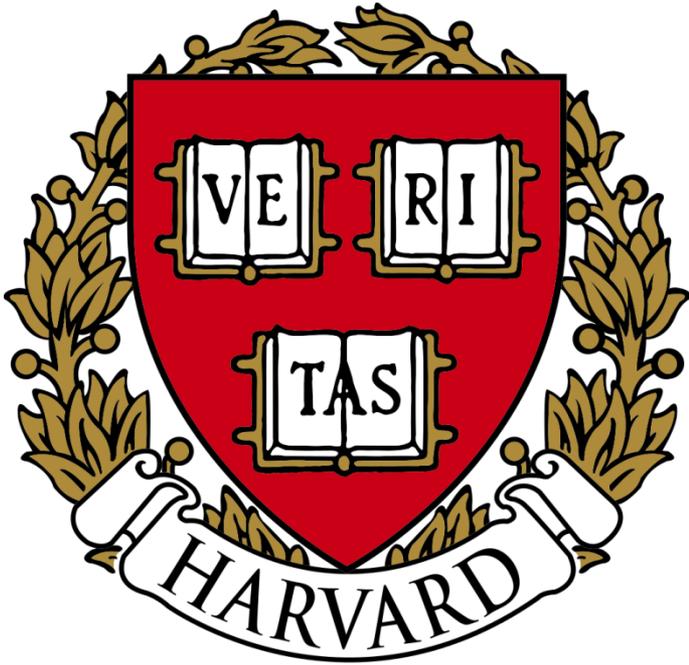
第二名袁績懋　　順天宛平縣人

第三名龐鍾璐　　江蘇常熟縣人
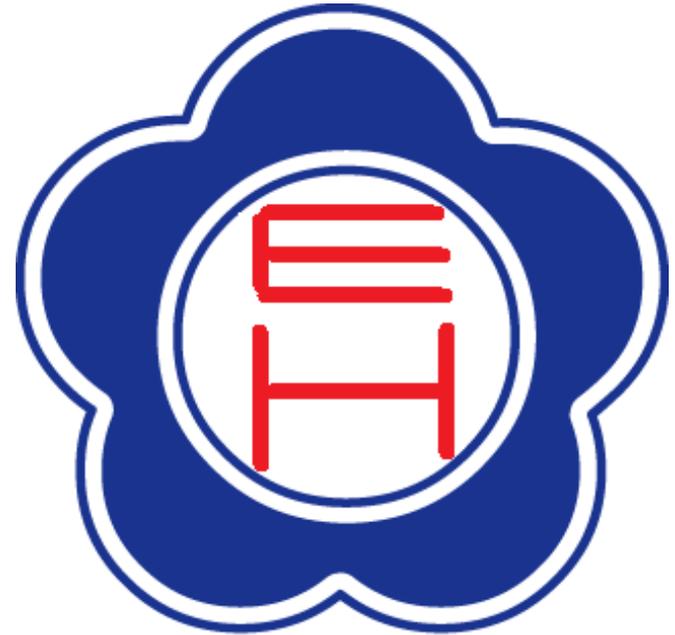
第二甲賜進士出身

第一名許彭壽　　浙江錢塘縣人
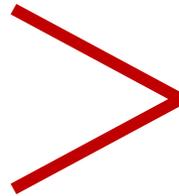
第二名孫觀　　安徽舒城縣人

第三名徐樹銘　　湖南長沙縣人

0370

Colleges

Harvard

Eastern Harvard

Students take a unite exam……

Centralized College Admission (CCA)
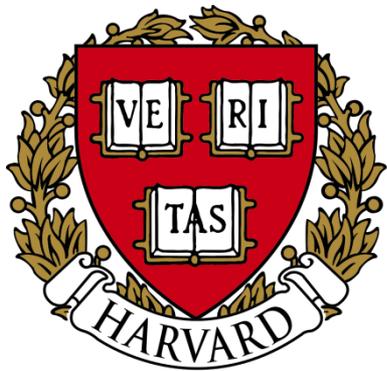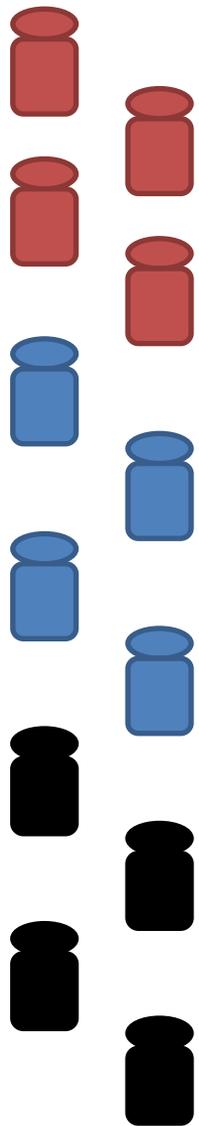
$q_H = 4$

$q_{EH} = 4$

Decentralized College Admission (DCA)
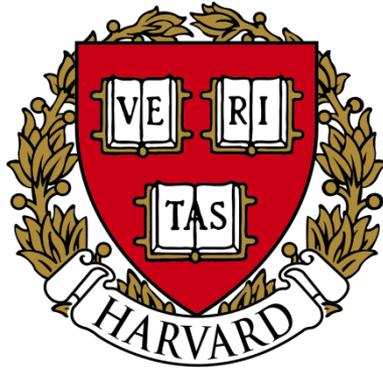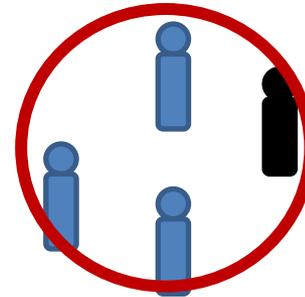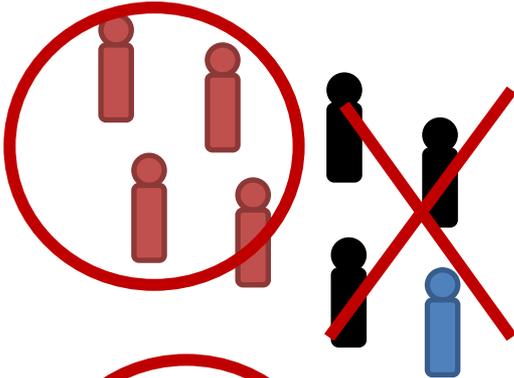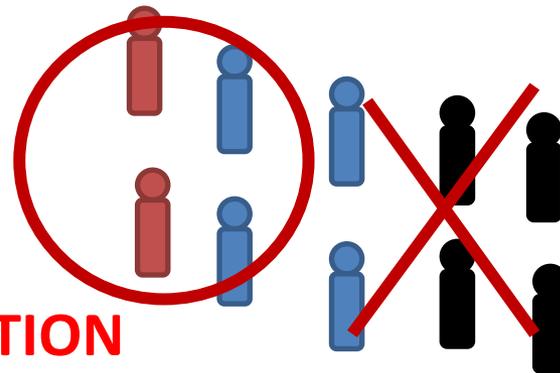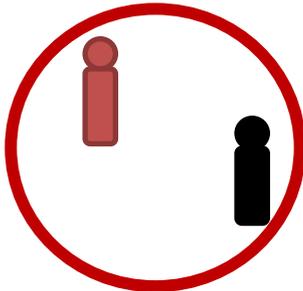
EXPERIMENT DESIGN

This experiment is going to test...

In different mechanism......

- how will smart/dumb students choose?
- Which kind of mechanism is more effective?

Experiment

- Hold in Berlin
- Treatments: CCA or DCA

- Participants = Students

Setting

COLLEGE 2

COLLEGE 1

Capacity = ?

Capacity = ?

- 12 students applying

Setting

- Students learn their own ability a_s
  - randomly drawn from $U[0, 100]$ each round.
  - pairwise for CCA and DCA
- **Choice 1**: Decide **effort level** e_s

  - Students' cost = $\dfrac{100e_s}{a_s}$

- **Choice 2**: Choose school (DCA)

# Centralized College Admission (CCA)
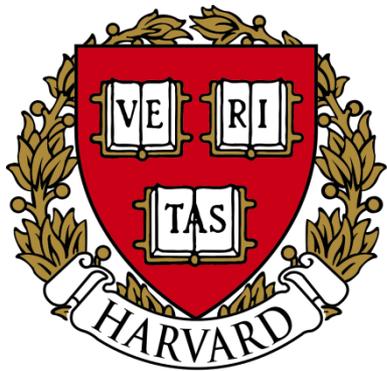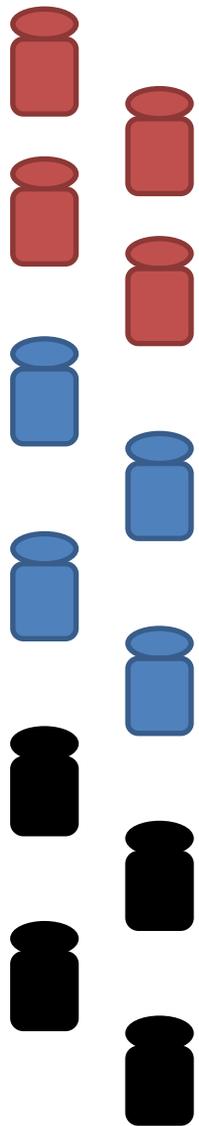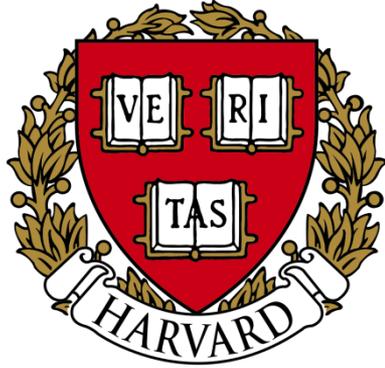
$$q_H = 4$$

$$q_{EH} = 4$$

# Decentralized College Admission (DCA)
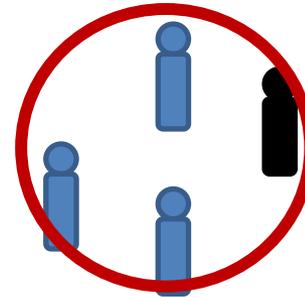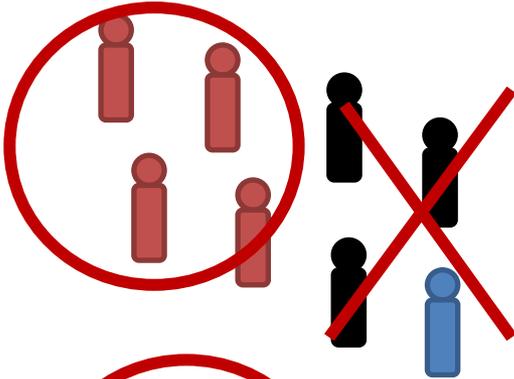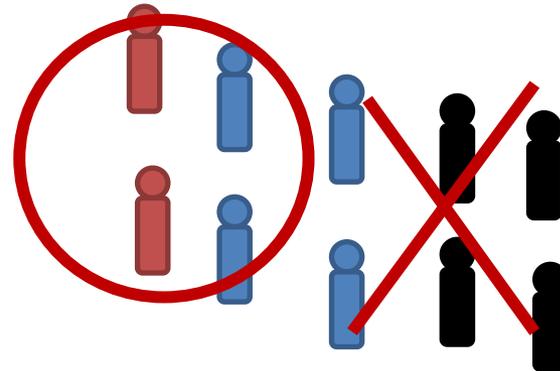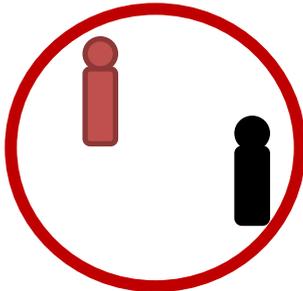
Payoff

- Endowment
- Cost of effort
- Value from school

$$2200$$

$$-\frac{100e_S}{a_S}$$

$$+v_H \text{ or } v_{EH} \text{ or } 0$$

Market Setting and Prediction

v_H / v_{EH}	Harvard	Logo	Higher Utility	Higher Effort
Market 1 [2000/1000]	6	6	CCA	DCA in Expectation
Market 2 [2000/1000]	2	2	DCA	Indifference in expect.
Market 3 [2000/1000]	2	8	DCA in Expectation	CCA
Market 4 **[2000/1800]**	3	9	CCA	DCA
Market 5 [2000/1000]	9	1	Indifference in expect.	Indifference in expect.

Theoretical Prediction

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Proposition 1

- In CCA, **high ability** students exert **high efforts**.

- Thus **smart students** (who with high ability level) **get admitted to the good college**; whereas **dumb students** (who with low ability levels) **get admitted to the bad college** (or even not accepted by any colleges.)

Theorem 1

- In DCA, there is **a cutoff of ability**, while the students' effort functions are continuous and monotone in ability level.

- The **smart students** (whose ability is over the cutoff) **play a pure strategy** that surely applying to the good college.

- The **dumb students** (whose ability is below the cutoff) **play a mixed strategy** when choosing between the two colleges.

Proposition 2

- **Dumb students prefer DCA to CCA** when there are **no enough seats** for all students.

- Very dumb students can **hardly have a chance to enter a college in CCA**, while **the probability of getting a seat is away from zero in DCA** due to fewer number of applications than the capacity.

- This proposition also holds in a more general ℓ colleges case.

Proposition 3

- **Smart students prefer CCA to DCA**.

- Smart students can **only get a seat in the good college in DCA**, whereas they can **get seats in both colleges in CCA**.

- Their **equilibrium probability of entering good college is the same** across the two mechanism.

- This proposition also holds in a more general ℓ colleges case.

Experimental Results

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Result 1: Expected utility

Table 2: Average utility

Market	Utility higher for all students (predicted)	Average utility higher for realized types (predicted)	Average utility in CCA (observed)	Average utility in DCA (observed)	Observed utilities different in CCA and DCA
1	CCA	CCA, 0.00	1223	1021	0.01
2	DCA	DCA, 0.02	111	86	0.75
3	depends; DCA in expectation	DCA, 0.00	603	576	0.75
4	CCA	CCA, 0.00	1058	747	0.00
5	no diff. in expectation	no diff., 0.63	1183	1160	0.63

Notes: Columns 3 and 6 show the p-values of the Wilcoxon rank-sum test for equality of the distributions.

- 1 & 4: consistent; CCA > DCA
  - potential miscoordination
- 2 & 3: inconsistent; CCA > DCA (insignificant)

Result 2: Effort levels

Table 3: Average effort

Market	Effort higher for all students (predicted)	Average effort higher for realized types (predicted)	Average effort in CCA (observed)	Average effort in DCA (observed)	Observed efforts different in CCA and DCA
1	depends; DCA in expectation	DCA, 0.06	276	362	0.04
2	no diff. in expectation	no diff., 0.15	389	410	0.75
3	CCA	CCA, 0.00	397	354	0.42
4	DCA	DCA, 0.00	191	340	0.02
5	no diff. in expectation	no diff., 0.75	400	395	1.00

Notes: Columns 3 and 6 show the p-values of the Wilcoxon rank-sum test for equality of the distributions.

- 1 & 4: consistent; DCA > CCA
  - Without a shortage of seats: CCA better
- 3: inconsistent; insignificant difference
- ➢ **CCA performs better than DCA.** *(Why?)*

Result 3: Expected utility of low- and high-ability students

Table 4: Utility differences across ability quantiles

Variable	Coefficient (Std. Err.)		
10% ability quantiles	49.008*** (8.069)	5th quantile in DCA	-79.696 (93.920)
1st quantile in DCA	98.812 (83.255)	6th quantile in DCA	-60.945 (92.340)
2nd quantile in DCA	294.889*** (76.675)	7th quantile in DCA	-278.143*** (91.047)
3rd quantile in DCA	234.895*** (73.484)	8th quantile in DCA	-103.370 (112.019)
4th quantile in DCA	57.848 (86.449)	9th quantile in DCA	-190.702 (118.914)
		10th quantile in DCA	-186.753** (110.123)

- <u>support</u> proposition 2 and 3

Market 1. Centralized admission system · Market 1. Decentralized admission system
Market 2. Centralized admission system · Market 2. Decentralized admission system
Market 3. Centralized admission system · Market 3. Decentralized admission system
Market 4. Centralized admission system · Market 4. Decentralized admission system
Market 5. Centralized admission system · Market 5. Decentralized admission system

● Effort levels in the lab
— Kernel regression of efforts in the lab (lowess)
— Equilibrium predictions for efforts

Overexertion of Effort

Table 5: Individual efforts

	Average observed efforts (1)		Average equilibrium efforts (2)	Average random efforts (3)	p-value obs.=pred. (4)	p-value obs.=rand. (5)
CCA						
Market 1	276		230	548	0.41	0.00
Market 2	389		364	567	0.74	0.00
Market 3	397	>	280	572	0.00	0.00
Market 4	191		35	553	0.00	0.00
Market 5	400		305	551	0.00	0.00
DCA						
Market 1	362		262	548	0.00	0.00
Market 2	410		309	567	0.00	0.00
Market 3	354	>	195	572	0.00	0.00
Market 4	340		125	553	0.00	0.00
Market 5	395		307	551	0.00	0.00

- Overexertion: DCA > CCA   *Intuition: uncertainty*
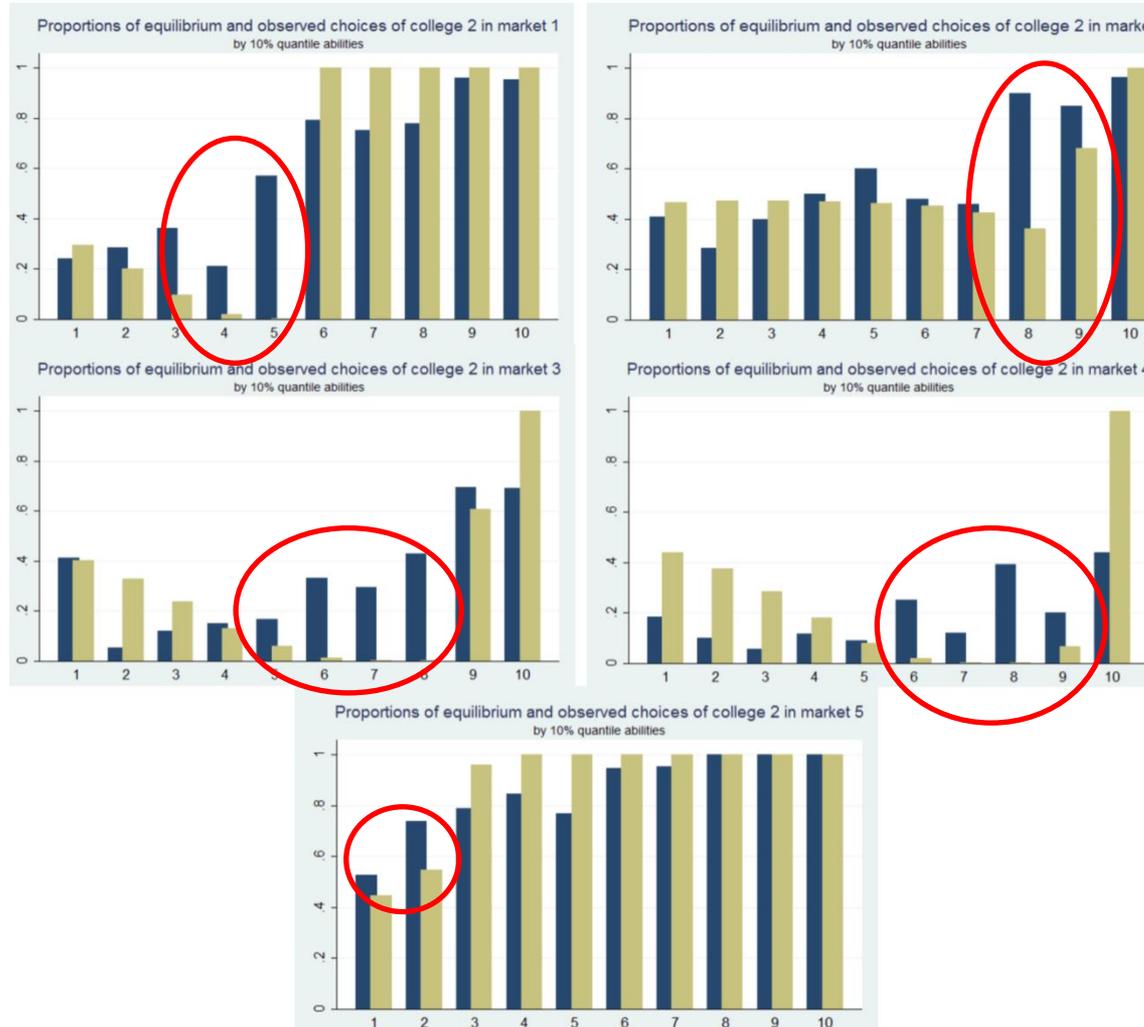
Result 5: Choice of college in DCA

Table 7: Proportion of choices of good college 2

	Equilibrium ability cutoff (1)	Equ. prop. of choices of college 2 below the cutoff (2)	Obs. prop. of choices of college 2 below the cutoff (3)	Obs. prop. of choices of college 2 above the cutoff (4)	p-values for equality of proportions above and below the cutoff (5)
Market 1	50	13%	33%	85%	0.00
Market 2	85.5	43%	51%	92%	0.00
Market 3	85.5	15%	27%	68%	0.00
Market 4	89.5	16%	17%	42%	0.00
Market 5	23.5	51%	64%	91%	0.00

Table 8: Choice of the good college 2 in DCA

Variable	Coefficient (Std. Err.)
Equilibrium probability of choosing the good college	1.684*** (0.106)
Intercept	-0.79*** (0.079)
N	1080
Pseudo R^2	0.177

Too Smooth Around The Cutoff

Proportions of equilibrium and observed choices of college 2 in market 1 by 10% quantile abilities

Proportions of equilibrium and observed choices of college 2 in market by 10% quantile abilities

Proportions of equilibrium and observed choices of college 2 in market 3 by 10% quantile abilities

Proportions of equilibrium and observed choices of college 2 in market 4 by 10% quantile abilities

Proportions of equilibrium and observed choices of college 2 in market 5 by 10% quantile abilities

under- or overestimate the cutoff

Observed proportion of choices of college 2
Equilibrium proportion of choices of college 2

Conclusion & Comment

- The data support the main predictions.
- DCA performs worse than CCA.
  - more pronounced overexertion in DCA
- ✓ Is the above conclusion general?
  - ➤ uncertainty or <u>unfamiliar</u>?
  - ➤ If the experiment is conducted in Japan…
- When effort increases our productivity…?