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Lying through Their Teeth: Third Party Advice and Truth Telling in a Strategy Proof Mechanism

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Abstract

We test the effect of advice on the well known top trading cycles (TTC) matching algorithm in a school choice frame work. We compare three treatments involving third party advice [right advice (R), wrong advice (W), and both right and wrong advice (RW)] to a no-advice baseline (B). In line with previous literature the truth telling rate is higher than 80% in the baseline, but it becomes as low as 35% in the W treatment. Truth telling rates are also significantly lower in R than in B, and much lower in RW than in B. This evidence suggests that a vast majority of participants in our experiment were confused. Truth telling seems to work only as a default strategy, and participants can be heavily influenced by advice. The real life implementation of matching mechanisms may have been misguided by some laboratory experimentation.

1. Introduction

The use of matching mechanisms for market design is one of the most successful real world applications of microeconomic theory. Matching mechanisms are currently used for markets such as medical schools for graduates (Roth 1984; Roth and Peranson 1999), housing for students (Chen and Sönmez 2002; Abdulkadiroglu and Sönmez 2003), school choice (Abdulkadiroglu, Pathak et al. 2005a; Abdulkadiroglu, Pathak et al. 2005b; Pathak 2011), and kidney exchange (Roth, Sönmez et al. 2004).

The proper matching mechanism can ensure that, in theory, final allocations will have such desirable properties as stability, and/or Pareto efficiency. Mechanisms can also be *strategy-proof*; that is, truthful preference revelation is the dominant strategy. Strategy-proof matching mechanisms are often preferred because they don't punish participants for not strategising correctly or, in order words, not finding the optimal way of lying.

Many experimental studies have found high rates of truthful revelation in strategy-proof mechanisms (between 70-95%[1]). It has been claimed that, if it weren't for a minority of confused participants who manipulate their rankings, truthful revelation would be universal (Chen and Sönmez, 2006). These results have been used as the rationale for applying such mechanisms to the field, Abdulkadiroglu et al. (2006b). In a similar vein, Pathak and Sönmez (2011) goes as far as suggesting that rankings in a strategy-proof mechanism can be used as "preference data" representing the quality of schools.

However, it may be the case that truth-tellers in laboratory experiments are not truthful because they understand the mechanism's strategy-proofness, but perhaps because they are just restating their induced preferences. Behaving in such a way does not require

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[1] Calsamiglia, Haeringer, and Klijn (2009); Pais and Pintér (2008); Pais, Pintér, and Vesteg (2011)

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much thinking. If participants do not understand strategy-proofness, preference reporting could be influenced by previously ignored environmental factors such as third party advice.

We run a one-shot, between subjects individual decision making matching experiment with a school choice frame. Participants were informed about markets being formed by only a human (themselves) and three payoff maximising computer players. Each experimental subject participated in just one of four treatments: a baseline and three advice treatments. The Baseline received no advice. The three advice treatments received the Right advice (truthful revelation), Wrong advice (manipulation), and mixed advice (both Right and Wrong) respectively. At the start of the experiment participants were given a detailed description of the TTC algorithm which included a solved example. Then they were asked to use TTC to solve an incentive based allocation problem. After finishing this task, participants were informed of their valuations for four schools, given the advice, and asked to submit a preference order. Each recommended action in the advice treatment, coming from a third party source, was accompanied by basic reasoning. Finally, a questionnaire was used to further investigate the understanding of the mechanism's strategy-proofness.

In line with previous research, participants reported their preferences truthfully 73% of the time in the baseline. Truthful preference revelation was significantly lower in all the advice treatments: 50% in R, 28% in W and 42% in RW.

Evidence of confusion in matching markets can be found in some matching experiments in which participants are given the option to enter the market and refuse to do so, even when entering the market has no potential downside, see for instance Chen and Sönmez (2002) and Guillen and Kesten (2010). A recent paper, Hugh-Jones et al. (2013), shows high confusion rates among participants facing the Probabilistic Serial Mechanism. More generally, the experimental literature is full of examples of seemingly irrational behaviour. Relatively simple games in which participants choose to play non-dominant strategies include

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the dictator game (Engel 2011), the ultimatum game (Oosterbeek, Sloof et al. 2004), the centipede game (Palacios-Huerta and Volij 2009), auction games (Kagel and Levin 1986) or public good games (Andreoni 1995). Yet, in most of these games it is often hard to disentangle social preferences from irrationality and confusion. Ferraro and Vossler (2010) managed to do so by using computer opponents. We followed the same design philosophy.

Our experiment shows that people are indeed highly influenced by advice and therefore must be unable to verify or assess the property of strategy-proofness for themselves. Our result suggests that we cannot expect agents in matching markets to act as if they were rational. This result may have important repercussions for the implementation of centralised matching markets. That is, more emphasis should be placed on encouraging and facilitating truthful preference revelation. This experiment opens multiple avenues for further research into decision making in matching markets.

2. A note on advice

If the description of the mechanism is unavailable, difficult to find, or too cryptic, many participants will be forced to base their decision on either intuition or some kind of advice. Despite the importance of advice in the field context, it has been so far almost ignored in the laboratory, an exception being Braun et al. (2011). In the context of school choice, advice from the establishment will commonly recommend a truthful revelation strategy.

The Boston Public School system adopted the strategy proof deferred acceptance (DA) algorithm in the mid -noughties following the suggestion of a group of experts lead by 2012 Nobel Laureate Alvin Roth, Abdulkadiroglu et al. (2005). DA replaced the old non-strategy proof Boston algorithm (BOS). Savvy parents learnt how to manipulate BOS and pass their

knowledge to their peers. Not-so-savvy parents were penalised by the BOS algorithm if they naively submitted their true preference order.[2]

The Boston Public School website contains advice about truthful revelation, but it is not easy to find. On top of that, there used to be workshops in which parents received detailed explanations about the workings of the mechanisms. There is some anecdotic evidence these forms of advice might have been unsuccessful. For instance, The Boston Globe, a well regarded local newspaper, ran a series of articles criticising the system mainly because parents were not satisfied with the possibility of their children attending schools far from their homes.[3] Nonetheless the matching mechanism itself was also accused of being cumbersome, essentially random, and hard to understand:

"A formula so complicated that only the most sophisticated parents understand it, the plan combines parental choice, the luck of the lottery, and a built-in preference to keep siblings together." – Boston Globe (2007)

Further than that, some popular blogs contain evidence of parents misunderstanding strategy-proofness. We did not find any blog reply clarifying that the mechanism cannot be manipulated.

"I love this school so much, but I can't bring myself to put it in my top three (You get put on the wait list for your top three schools.). I can't see wasting a wait list spot like that, no matter how much I love a school. Strategy-wise, if you're intent on sending your child to the Manning at K1, you almost have to put it as your #1 choice to have a shot at getting in. I already have one Hail Mary school in my top 3, so I have to be practical about this. Sadly, the Manning will likely be choice #4 for us." – Geeky Mama (2010)

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[2] DA is going to be replaced in 2014 by yet a new algorithm that guarantees a school of similar quality to the ones in the neighbourhood.

[3] That has to do also with the history of forced busing coming back from the '70s.

"The Kilmer has a ratio of 6.41 applicants per seat. The Lydon is 6.50. The ratio is a little better for other popular schools like the Beethoven, but they still have 4 applicants per seat. I just don't see how most people are getting their first or second choice with numbers like these." – googiebaba (2009)

In a context in which many parents do not understand the matching algorithm and many distrusted and hated the system, manipulation may have been more than likely. A recent and pertinent example of the implementation of TTC is the OneApp enrolment solution for students and public schools employed in the Recovery School District of New Orleans, USA. Information about how to submit preferences was limited. Correct advice was found online at NOLA.com, the local newspaper, Vanacore (2012), which cites the authority of the mechanism designers:

"The experts who developed the algorithm -folks from Duke, Harvard and MIT- say there is no way to game the system. If what you really want is a seat at KIPP Renaissance High School, you should not rank Sci. Academy first, thinking that you're more likely to get your second choice. Ranking KIPP as your top choice gives you your best shot at getting in."[4]

We did not find any statement regarding truthful revelation, or condemning preference manipulation, is present on the Recovery School District website, or the OneApp form. Finding this information would require the participants to engage in personal research. As a gauge of interest and available effort, an informative video linked in a Louisiana Department of Education press release, totalled only 100 views after the first application of TTC was

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[4] Vanacore, A. (2012). "Centralized enrollment in Recovery School District gets first tryout." Retrieved 01/10/2012, from http://www.nola.com/education/index.ssf/2012/04/centralized_enrollment_in_reco.html.

complete[5]. Likewise the New York City department of education does not contain any advice about truthful revelation for their High School deferred acceptance admission system.

3. Experimental procedures and design

The experiment consists of 4 sessions run over 2 days, run in the experimental Behavioural Research Laboratory at the University of Sydney. Each session involved an average of 27 participants. In each session participants were randomly allocated to a treatment group via a card draw. Participants were recruited using the School of Economics' Online Recruitment System for Economic Experiments (ORSEE). The participants were students of the University of Sydney, primarily aged 18-25. The experiment program was coded by the authors using the z-Tree, Fischbacher (2007).

Participants were given 10 minutes to read the experimental instructions.[6] They were able to progress at their own pace for the rest of the experiment. Participants had to complete an incentive based quiz, solving a TTC allocation problem. Then they were informed about their house values, given advice if in one of the advice treatments, and asked to submit their preference order. Finally, participants answered a questionnaire about their involvement in the task and their understanding of TTC.

The quiz was an allocation problem with 6 students and 3 schools with 2 places each. The participants were given 10 minutes to find the correct allocation. Feedback was not given until the end of the experiment.

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[5] Recovery School District (2012). "RSD Enrollment (English).wmv."   Retrieved October 30, 2012, from <http://www.youtube.com/watch?v=FnfGNs34Gf0/>
[6] The instructions were modelled on the instructions used by Pais and Pinter (2008) and are included in Appendix A.

The school environment in the student allocation task consisted of 4 districts, each containing a school. The districts were populated by the participant (denoted by H) and 3 "profit maximising" computer players (denoted by 1, 2 and 3). Each school has only one vacancy, but school districts B and D are congested (see table 1). The manipulation strategy is clear; switching schools B and D in the reported preferences is consistent both with District School Bias (DSB) and Small School Bias (SSB), Chen and Sönmez (2006).

Table 1: School values and local students

	Value ($)	Local Students
School A	10	
School B	20	1,2
School C	5	
School D	15	H,3

The stakes for the allocation task are comparable to previous experiments including Chen and Sönmez (2006), Pais and Pintér (2008), Pais et al. (2011), and Calsamiglia et al. (2009). Participants were informed which school they were allocated immediately after the task and before the questionnaire.

Participants in each session were randomly assigned to one of 4 groups: In the [B]aseline they received no advice; in the [R]ight advice treatment they received correct advice - to report their true preference ranking; in the [W]rong advice treatment they were given incorrect advice - to over-report their preference for their local school; in the "mixed" treatment [RW] they received both these pieces of competing advice. In the mixed treatment the ordering of the two pieces of advice was randomised to avoid a primacy effect. Each piece of advice consisted of a recommended action and some simple reasoning. For ease of comprehension and to maintain consistency between treatments the advice was limited to two sentences.

To avoid experimental demand effects, the advice was presented as third party and without endorsement. The advice was prefaced with the following disclaimer:

"The following is an example of advice about school allocation procedures which may be found in a newspaper or by word of mouth. It has been stylized to fit the context of this experiment. It is only here for you to consider and is not an instruction"[7]

Right Advice

"The mechanism is designed so that truthful reporting maximizes your chances of getting favoured schools. You should rank the schools in order of their true value to you."

Wrong Advice

"Since the top schools will have many applicants you should be realistic and apply to schools where you are likely to gain acceptance. If your local school is quite good you should put it as your first preference."[8]

Advice was given as part of the information package about the specific matching environment. Placing it on the same screen devalued its importance and even gave participants the chance to ignore it (5 participants reported not reading the advice).

The questionnaire served three main purposes: to ascertain the participants' use of the advice, to question the participants' understanding of the mechanism, and to determine any unintended side effects of exposure to advice on participants' feelings and beliefs.

Participants were not rewarded for their answers to these questions so one could object to the answers' validity. However, this is standard procedure in experimental work.

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[7] pluralised for the mixed treatment

[8] The wrong advice is noticeably more intuitive than the correct advice. This is ultimately a fault of the mechanism's complexity rather than the experimental design. Strategy-proofness is a complex and hard to explain in just two lines. On the other hand, avoiding congestion at popular schools can be easily explained. In any case fully rational individuals should disregard advice.

The questions crucial to the experimental hypotheses are discussed below. Additionally, participants were asked questions about their feelings of involvement and satisfaction. However, no conclusions could be made from these items. A summary of questionnaire responses is included in the Appendix.

4. Results

Table 2 presents the reported first preference of participants in each treatment group. School B was the 'correct' or 'truthful' first preference. Of those who revealed their true first preference only 4 participants deviated amongst their other rankings.

Table 2: Reported First Preference by Treatment Group.

| Advice group | Reported First Preference | | | | |
	School A	School B	School C	School D	Total
Baseline	0	21	0	5	26
Right	1	14	1	12	28
Wrong	0	10	0	19	29
Mixed	0	11	0	15	26
Total	1	56	1	51	109

In the baseline participants reported their first preference truthfully 81% of the time. This is comparable to measurements from previous studies. However, in each advice treatment manipulation is higher by a large and significant amount. The proportion of truthful revelation (for the whole ranking, not just the first preference) is shown in Figure 1.

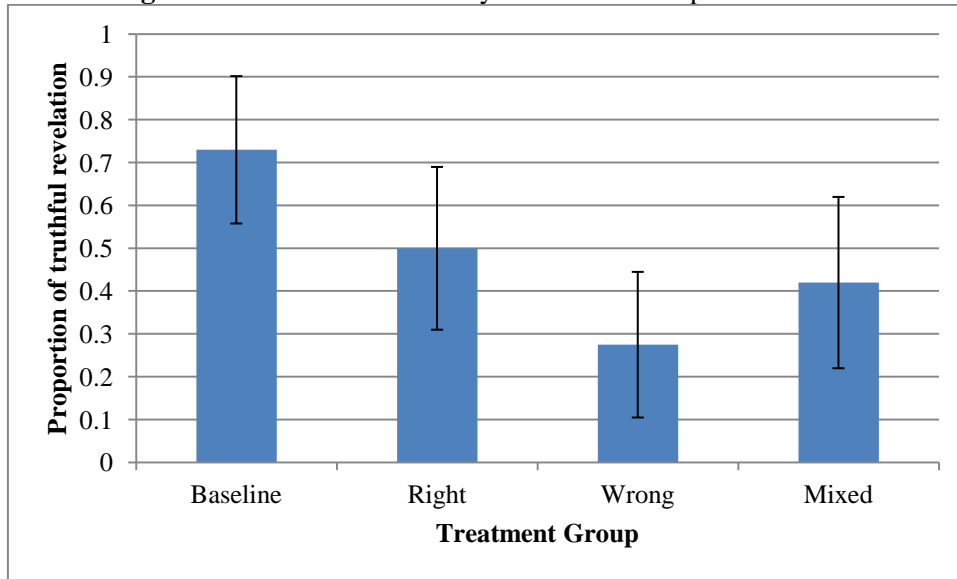**Figure 1**: Truthful revelation by Treatment Group with SE bars

Table 3: Two-group tests of proportions for truthful revelation between Treatment Groups (z-score, SE in brackets).

	Baseline	Right	Wrong	Mixed
Baseline		0.231*	0.455***	0.308**
		(0.13)	(0.14)	(0.14)
Right	-0.231*		0.224*	0.077
	(0.13)		(0.13)	(0.14)
Wrong	-0.455***	-0.224*		-0.147
	(0.14)	(0.13)		(0.13)
Mixed	-0.308**	-0.077	0.147	
	(0.14)	(0.14)	(0.13)	

***Significant at the 1 percent level
** Significant at the 5 percent level
* Significant at the 10 percent level

z-Tests of proportions indicate that all treatment groups differ significantly from the baseline, jointly ($p < 0.01$) and individually (see Table 3). Participants were also significantly more likely to tell the truth in the Right advice treatment when compared to the Wrong advice treatment. Truthful revelation in the mixed advice treatment did not differ significantly from either of the other advice treatments.

Most participants managed to find the right answer for the incentive based quiz, but we found no correlation between being able to solve the quiz and reporting the true preference order.

We found even further evidence of confusion. Most of the truth tellers who did not get into a good school made it clear in the questionnaires that they would be willing to manipulate their preference order if they had a chance to play the game again, see tables 4 and 5. Moreover, and also according to the questionnaire, a majority of participants in the advice treatments would have adjusted their strategy if given the computer players' preferences, see table 6. This included a large proportion of participants who told the truth.

Table 4: Participants' response to the "Reconsider" question arranged by treatment group

Treatment Group	Manipulated			Truth		
	Stay	Reconsider	% Reconsider	Stay	Reconsider	% Reconsider
Baseline	3	2	0.40	15	6	0.29
Right	4	6	0.60	5	2	0.29
Wrong	12	7	0.37	8	2	0.20
Mixed	10	5	0.33	7	3	0.30
Total	29	20	0.41	35	13	0.27

Table 5: Participants' response to the "Reconsider" question arranged by school value obtained

School Value	Manipulated			Truth		
	Stay	Reconsider	% Reconsider	Stay	Reconsider	% Reconsider
20	13	3	0.19	19	1	0.05
15	12	9	0.43	12	7	0.37
10	4	8	0.67	4	4	0.50
5	2	2	0.50	0	9	1.00
Total	31	22	0.42	35	21	0.38

Table 6: Participants' response to the "PC Preferences" question arranged by treatment group

Treatment Group	Manipulated			Truth		
	Stay	Change	% Change	Stay	Change	% Change
Baseline	4	1	0.20	14	7	0.33
Right	1	9	0.90	4	3	0.43
Wrong	6	13	0.68	2	8	0.80
Mixed	3	12	0.80	5	5	0.50
Total	14	35	0.71	25	23	0.48

5. Discussion and conclusions

TTC is a considerably complex mechanism. Its lack of transparency may be critical factor facilitating truthful revelation in our baseline treatment and previous laboratory experiments. This relation with complexity may invert when advice is introduced if the mechanism's intricacy makes correct advice difficult to believe. Although TTC is a complex mechanism, the designed environment of this experiment's matching market was intentionally made as simple as possible. The school environments in real applications of matching algorithms are considerably more extensive. It is not clear how the complexity of the environment could relate to truthful revelation rates. Gino and Moore (2007) point out that complexity would increase participants' reliance on advice. This provides a course for further research. Other experiments have shown that participants are less likely to follow bad (non-optimal) advice (Croson and Marks 2001; Cason and Sharma 2006; Duffy and Feltovich 2010). In fact, in Duffy and Feltovich (2010) most participants quickly learnt not to follow bad advice. It needs to be noted that there were no opportunities to learn in our experiments, as it was a realistic one shot design. Since a lottery is used to break priority ties, learning would have been difficult in a repeated game design. It is not a coincidence the bloggers write about the "Boston Public School Lottery."

One could also assert that truthful revelation in matching experiments is encouraged by the low stakes. Participants may have seen truthful revelation as a "gamble" for the highest valued school. This is confirmed by the dissatisfaction shown by participants who received their local school even after ranking it as their highest preference. These participants often reported that they would reconsider their strategy, and in open questions some stated they should have tried to get the highest valued school. It is quite likely that a proportion of

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truth-tellers are in fact just gamblers. This could be investigated in a further experiment by raising the payoffs considerably, or modifying the differential between school values. It needs to be notes that the payoffs in our experiment are consistent with the experimental literature. Another alternative hypothesis is that giving the participants advice implies experimental manipulation. Participants may be discouraged to tell the truth since replicating the given order may seem too simple to warrant experimentation. In any case, the ability to understand the mechanism's strategy-proofness should have negated any of these alternative explanations for our main result.

References

Recovery School District (2012). "RSD Enrollment (English).wmv." Retrieved October 30, 2012, from
http://www.youtube.com/watch?v=FnfGNs34Gf0.

Abdulkadiroglu, A., P. Pathak, et al. (2006). Changing the Boston School Choice Mechanism, NBER Working
Paper No. 11965

Abdulkadiroglu, A., P. A. Pathak, et al. (2005a). "The New York City High School Match." American
Economic Review **95**(2): 364-367.

Abdulkadiroglu, A., P. A. Pathak, et al. (2005b). "The Boston Public School Match." American Economic
Review **95**(2): 368-371.

Abdulkadiroglu, A. and T. Sönmez (2003). "School choice: A mechanism design approach." The American
Economic Review **93**(3): 729-747.

Andreoni, J. (1995). "Cooperation in public-goods experiments: Kindness or confusion?" The American
Economic Review **85**(4): 891-891.Boston Globe, 'School-assignment plan - a relic in need of a full
overhaul' (2007), accessed 13 December 2011, <
http://www.boston.com/bostonglobe/editorial_opinion/editorials/articles/2011/12/13/school_assignme
nt_plan___a_relic_in_need_of_a_full_overhaul/>

Braun, S., Dwenger, N., Kubler, D., Westkamp (2011). "Implementing Quotas in University Admissions: An
Experimental Analysis", Working Paper of the Max Planck Institute for Tax Law and Public Finance
No. 2011-22

Calsamiglia, C., G. Haeringer, et al. (2009). Constrained School Choice: An Experimental Study, Fondazione
Eni Enrico Mattei.

Cason, T. N. and T. Sharma (2006). Recommended Play and Correlated Equilibria: An Experimental Study,
Purdue University, Department of Economics.

*Chen, Y. (2003). Incentive-Compatible Mechanisms for Pure Public Goods: A Survey of Experimental
Research. The Handbook of Experimental Economics.

Chen, Y. and T. Sönmez (2002). "Improving Efficiency of On-Campus Housing: An Experimental Study."
The American Economic Review **92**(5): 1669-1686.

Chen, Y. and T. Sönmez (2006). "School choice: an experimental study." Journal of Economic Theory **127**(1):
202-231.

Croson, R. and M. Marks (2001). "The effect of recommended contributions in the voluntary provision of
public goods." Economic Inquiry **39**: 238–249.

Duffy, J. and N. J. Feltovich (2010). "Correlated Equilibria, Good and Bad: An Experimental Study."
International Economic Review **51**(3).

Engel, C. (2011). "Dictator games: a meta study." Experimental Economics **14**(4): 583-610.

Ferraro, P. J. and C. A. Vossler (2010). "The Source and Significance of Confusion in Public Goods Experiments." BE Journal of Economic Analysis & Policy **10**(1): 42.

Fischbacher, U. (2007): z-Tree: Zurich Toolbox for Ready-made Economic Experiments, Experimental Economics 10(2), 171-178.

Geeky Mama (2010), 'Manning school preview - Jan. 20', Braving the BPS Lottery, blog post, January 20, 2010, accessed 11 July 2013, < http://bravingthelottery.blogspot.com.au/2010/01/manning-school-preview-jan-20.html >.

Gino, F. and D. A. Moore (2007). "Effects of Task Difficulty on Use of Advice." Journal of Behavioral Decision Making 20: 21-35.

googiebaba (2009), blog comment, to "Everything I needed to know I learned in Kindergarten except how to get my kid into a good one", December 12, 2009, *Mommy on the Floor*, Accessed: 11 July 2013,< http://momandmama.wordpress.com/2009/12/12/everything-i-needed-to-know-i-learned-in-kindergarten-except-how-to-get-my-kid-into-a-good-one/>

Guillen, P. and O. Kesten (2010). "Matching Markets with Mixed Ownership: The Case for A Real-life Assignment Mechanism." International Economic Review, 53(3), 1027-1046.

Hugh-Jones, D., Kurino, M., Vanberg, C. (2013). "An Experimental Study on the Incentives of the Probabilistic Serial Mechanism", WZB Discussion Paper SP II 2013–204, May 2013

Kagel, J. H. and D. Levin (1986). "The Winner's Curse and Public Information in Common Value Auctions." The American Economic Review **76**(5): 894-920.

Oosterbeek, H., R. Sloof, et al. (2004). Cultural differences in ultimatum game experiments: Evidence from a meta-analysis, EconWPA.

Pais, J. and Á. Pintér (2008). "School choice and information: An experimental study on matching mechanisms." Games and Economic Behavior **64**(1): 303-328.

Pais, J., Á. Pintér, et al. (2011). "College Admissions and the Role of Information: An Experimental Study." INTERNATIONAL ECONOMIC REVIEW **52**(3): 713-737.

Palacios-Huerta, I. and O. Volij (2009). "Field Centipedes." American Economic Review **99**(4): 1619-1635.

Pathak, P. A. (2011). "The Mechanism Design Approach to Student Assignment." Annual Review of Economics **3**(1): 513-536.

Pathak, P. A. and T. Sönmez (2011). School Admissions Reform in Chicago and England: Comparing Mechanisms by Their Vulnerability to Manipulation, National Bureau of Economic Research, Inc.

Roth, A. E. (1984). "The Evolution of the Labor Market for Medical Interns and Residents: A Case Study in Game Theory." Journal of Political Economy **Y2**(6): 991-1016.

Roth, A. E. and E. Peranson (1999). "The Redesign of the Matching Market for American Physicians: Some Engineering Aspects of Economic Design." American Economic Review **89**(4): 748–780.

Roth, A. E., T. Sönmez, et al. (2004). "Kidney Exchange." The Quarterly Journal of Economics **119**(2): 457-488.

Vanacore, A. (2012). "Centralized enrollment in Recovery School District gets first tryout."   Retrieved 01/10/2012, from

http://www.nola.com/education/index.ssf/2012/04/centralized_enrollment_in_reco.html.

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