Laboratory Experiments in Political Economy

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Abstract

This article summarizes a small part of the literature on laboratory experiments in political economy. The experiments discussed are primarily aimed at testing predictions of equilibrium models of voting in committees and elections. The specific topics discussed are voter turnout, the Condorcet jury theorem, and the swing voter's curse. The latter two topics address questions of information aggregation by voting rules. All the experiments find significant evidence of strategic voting and, with a few exceptions, find support for the equilibrium predictions of the theories.

INTRODUCTION

Committees and small-scale elections have been studied in the laboratory for more than four decades. In such experiments, human subjects make group decisions according to different voting procedures, institutional rules, or committee bargaining protocols. Decision making takes place over a period of time, generally in the range of one to three hours, and money is used to create an incentivized environment. Subjects earn different amounts depending on the decisions they make and the group outcomes. This incentivization procedure, known as induced value, was developed by Vernon Smith for economics experiments, and its validity has been widely established by thousands of experiments in political science, economics, management science, finance, marketing, and related fields for more than half a century.

Laboratory experiments permit direct observation of choice behavior in parametrically controlled environments, which in turn permits unusually sharp tests of theoretical predictions developed by political economists and social choice theorists. Such detailed parametric control of the environment is often the only way to directly test the extremely precise hypotheses generated by complex mathematical theories of committees, elections, and voting behavior. Laboratory experiments also allow testbedding new voting procedures to see how they function before they are implemented in practice (see, e.g., Casella et al. 2006, Forsythe et al. 1993).

Most political economy experiments are theory driven. The theoretical framework for these experiments usually comes from noncooperative game theory, cooperative game theory, or the theory of competitive equilibrium in markets. Experiments in the tradition of cooperative game theory, committee bargaining, and electoral competition have been surveyed elsewhere (Palfrey 2006, McKelvey & Ordeshook 1990).[1] The category of experiments based on equilibrium theories of markets would include laboratory studies of pricing in prediction markets, such as the Iowa Electronic Market, and also experiments based on rational expectations equilibrium and information aggregation, such as McKelvey & Ordeshook (1985). Because of limited space, this article focuses on political economy experiments that test noncooperative game theoretic models of behavior and equilibrium.

Experiments testing predictions generated from models that apply noncooperative game theory are concerned with the empirical validity of Nash equilibrium or related equilibrium notions (subgame perfection, Bayesian equilibrium, or quantal response equilibrium). In such experiments, the experimental protocol follows as precisely as possible the specification of order of moves and payoffs of an extensive form game. An equilibrium concept pins down quantitative and sometimes probabilistic predictions about behavior in the experiment. Different equilibrium concepts may imply different predictions, so experiments of this sort also help theorists understand the empirical limitations of different equilibrium concepts—leading to progress in game theory more generally. In addition, these equilibrium concepts imply how changes in the parametric environment can lead to changes in behavior and outcome; these "comparative static predictions" are qualitative, and predict the direction of change in behavior.

We discuss game theoretic political economy experiments of two different kinds. The first is voter turnout. The second is information aggregation by voting. Both address theories that are based on game theory, and the voter calculus derives from the expected-utility implications and likelihood of "pivotal events," that is, when a single vote can make the difference in the election. We only scratch the surface of the large literature on political economy experiments, even just the literature on those testing the implications of noncooperative game theory. There is a large and growing body of experimental results on committee bargaining, based on variations and extensions

[1]Additional articles and discussion of the literature can be found in Palfrey (1991) and Kinder & Palfrey (1993).

of the legislative bargaining model of Baron & Ferejohn (1989). There are experiments on stochastic game models of legislative institutions (see McKelvey 1991; Frechette et al. 2003, 2005; Diermeier & Gailmard 2006, and the references they cite), the effect of sequential versus simultaneous voting methods (see Battaglini et al. 2007, Ali et al. 2008), and many other subjects. Beyond this, there exists a huge body of experimental results on more general game theoretic questions that are fundamental to basic issues in political science: cooperation, repeated games, information transmission, reciprocity, trust, and so forth.

VOTER TURNOUT

Understanding the forces behind voter turnout has been an important and difficult challenge for political scientists, especially formal theorists. Central to the question is the so-called paradox of not voting. Interestingly, this paradox was introduced to political science, not by critics of rational choice theory, but by some of the pioneers of positive political theory. Downs (1957) and Riker & Ordeshook (1970) clearly identify what appears to be an enigma due to a collective action problem. In large elections, the probability a single voter casts a decisive ballot is very small. This implies that if the cost of voting is more than negligible, and voters care only about the instrumental value of voting (i.e., its impact on the outcome of the election at hand), then voting is irrational. The optimal strategy is to abstain. However, if everyone follows this rationality argument, then nobody will vote. If nobody else votes, the probability a voter's ballot is decisive would be one! That is, if one expects everyone to follow the first rationality calculus, then the rational response is to *not* follow that calculus, but actually vote. Hence the paradox.

Of course there is a resolution, using the modern tools of game theory. Ledyard (1981) and Palfrey & Rosenthal (1983, 1985) model this as a participation game and characterize equilibrium turnout. The main finding is that, as long as there is a sufficient amount of uncertainty about other voters' incentives to vote, then in a large election, only voters with negligible voting costs will vote. Thus, the original calculus of voting turns out to be approximately consistent with the equilibrium analysis of game theory. Turnout rates should reflect the proportion of the population with negligible voting costs (or sufficient citizen duty or consumption value to voting to offset their voting costs).

The question reduces to why there is significant turnout in elections. Is it because voters ignore the strategic calculus of voting, which is based on notions of pivotality, that is, the probability of casting a decisive ballot? Is it because voters like to vote? Is it because the equilibrium assumption is completely wrong? Or is it that voters are irrational?

These questions are extremely difficult to answer using field data.[2] The theoretical predictions generally depend on variables that are almost impossible to measure or even to approximate using observable variables. Careful testing of the theory is a critical first step to assessing its empirical relevance. In this case, where the driving variables in the model are difficult to observe or measure accurately from field data, the best source of data is the laboratory, where one can observe small and medium-sized, carefully controlled elections.[3]

Levine & Palfrey (2007) conduct exactly this sort of test of a rational choice model of voter turnout. As in most laboratory experiments, specific aspects of the environment are controlled and manipulated by the experimenter. For the voter-turnout experiment, these variables include the total number of eligible voters for the election, the distribution of voter support for the (two) candidates, and the exact preferences of each voter, including their

[2]There have been a number of interesting field experiments on voter turnout, but these typically address a different set of questions (see, e.g., Gerber & Green 2000).

[3]There have been some attempts to apply structural modeling techniques to carefully selected field data sets (Hansen et al. 1987, Coate & Conlin 2004). However, these approaches start out assuming the theory is correct and then estimate the parameters of the model. Model validation is then attempted ex post.

voting cost and the differences in the utility for their first-choice candidate winning compared to their second choice. Also controlled is the distribution of these preferences, and the amount of information each voter has about his own preferences and about the distribution of preferences of the other voters.

The theoretical predictions are derived from a generalized version of the Palfrey & Rosenthal (1985) model of voter turnout under conditions of strategic uncertainty. Voters weigh the costs and benefits from voting or abstaining, taking account of the fact that their vote only matters if it is pivotal. The equilibrium assumption is that voters correctly perceive the probability of being pivotal, on average.

Three hypotheses are implied by the theory. The "size effect" hypothesis is that, keeping constant the distribution of preferences, turnout will decrease with the number of eligible voters. The "competition effect" hypothesis is that, keeping constant the size of the electorate, turnout will be higher as the number of eligible voters favoring each candidate is closer to 50%. The "underdog effect" hypothesis is that supporters of the minority candidate (i.e., the candidate favored by less than half the number of eligible voters) will turn out at a higher rate than the supporters of the majority candidate.

The experiment gathers extensive data for elections with eligible-voter group sizes of 3, 9, 27, and 51. For each size there is a "tossup" election, where the majority candidate has exactly one more supporter than the minority candidate. For each size there is also a "landslide" treatment, where the majority candidate has twice as many supporters as the minority candidate. In the three-voter case, these two competition treatments are the same. Also, the three-voter case is special because it has a "reverse underdog effect." That is, majority-party voters are predicted to vote with higher probability than minority-party voters.

Overall, their dataset includes 2350 elections and >30,000 observations of individual turnout decisions. Each decision is incentivized; subjects earn an extra monetary bonus for each election that their candidate wins, and if they choose to vote rather than abstain, they forego a private opportunity cost that varies across elections from 0 to about half the winning bonus. Each voter participates in 100 elections, which are conducted independently during the course of a two-hour session. Subjects are carefully instructed on the exact rules of how their earnings are computed (as described above). Everything is explained in detail to all participants, with no deception, and every subject must pass a comprehension quiz before starting the experiment.

The findings are striking. All of the comparative static properties of the model—the size effect, the competition effect, the underdog effect, and even the reverse underdog effect—are observed in the data. **Table 1** compares the equilibrium turnout rates and the actual turnout rates in the experiment, for each treatment.

Another way to view the data is in terms of political outcomes rather than individual turnout choices. For each treatment, one can compute the probability a voter is pivotal (in equilibrium), where pivotal means that the election is either a tie or one vote away from a tie. One can also compute the probability (in equilibrium) that the minority party will score an upset victory (with ties counted as half an upset). The correlation between the predicted and actual frequency of pivotal events and upsets is

Table 1 Percentage turnout: equilibrium versus data (Levine & Palfrey 2007)

Party sizes	2–1	5–4	6–3	14–13	18–9	26–25	34–17
Equilibrium minority turnout	54	41	46	27	30	21	24
Actual minority turnout (data)	53	44	48	38	38	33	39
Equilibrium majority turnout	64	37	45	23	30	17	23
Actual majority turnout (data)	59	40	45	28	36	27	36

nearly perfect. A simple regression of predicted on actual values of these numbers yields an R-squared of 0.99. The estimated intercept is 0.01 and the estimated slope coefficient is 1.03.

Not only are the qualitative predictions of the theory supported in the data, but the quantitative deviations from equilibrium theory in this experiment are rather small in magnitude. These deviations from theory, though small, are systematic and therefore suggest a closer look. From **Figure 1**, it is easy to see that turnout rates, while clearly moving in the same direction as predicted turnout rates, respond somewhat more sluggishly to parameter changes than theory would predict. Put another way, the turnout rates are generally closer to 50% than theory would predict. For example, actual turnout rates in the $n = 3$ treatment are less than predicted, whereas turnout rates for the $n = 27$ and $n = 51$ groups are greater than predicted. Levine & Palfrey (2007) show that "quantal response equilibrium" theory can account for the direction of these deviations from Nash equilibrium predictions. Quantal response equilibrium in these voter turnout games predicts greater turnout than Nash equilibrium when the Nash equilibrium predicts low turnout (below 50%) and less turnout when Nash equilibrium predicts high turnout (above 50%). This is consistent with the findings of the experiment. The article also shows (theoretically) that quantal response equilibrium theory can generate surprisingly large turnout even in mass elections. They find that plausible levels of voting costs and benefits from a voter's party winning rationalize turnout rates on the order of 40% to 50% in elections with 200,000,000 eligible voters, in a quantal response equilibrium based on parameters calibrated from the experiment.

Some other experiments on voter turnout (Schram & Sonnemans 1996a,b) are discussed in Palfrey (2006). Goeree & Holt (2005) address some related questions about political participation and show how the logit quantal response equilibrium can account for deviations from Nash equilibrium. Grosser & Schram (2006) show that there are significant information effects in political participation. Specifically, they

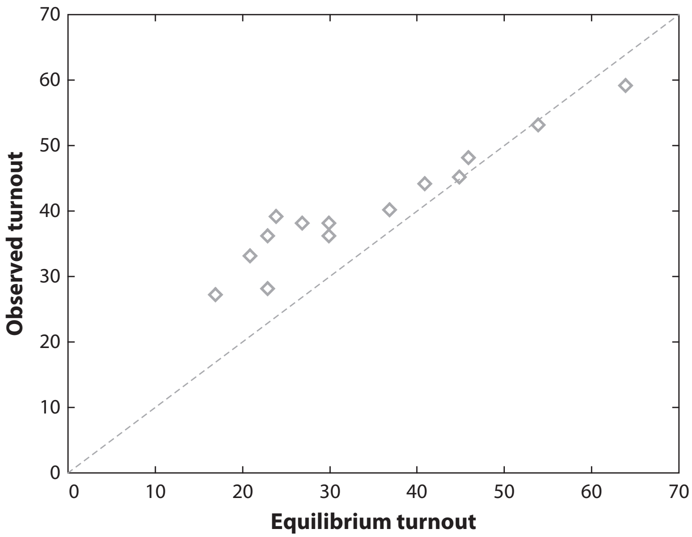

Figure 1

Actual versus equilibrium turnout.

find that voters are more likely to vote if they receive information that other voters are voting (or intend to vote) at higher rates. A more recent experiment has explored the question of how voters in laboratory elections perceive the probability their vote will be pivotal, and how they act on these perceptions (Duffy & Tavits 2008). Duffy & Tavits use belief-elicitation procedures and find that voters in their experiment are more likely to vote the more likely they think their vote will be pivotal. They also report that subjects overestimate the probability they will be pivotal, but this misperception declines significantly with experience. However, surprisingly, this higher average perceived probability of being pivotal does not lead to aggregate turnout rates that are significantly different from the Nash equilibrium. Overestimation of small probabilities has been reported in psychology experiments as well (see, e.g., Prelec 1998).

INFORMATION AGGREGATION IN COMMITTEES AND ELECTIONS

The original model of information aggregation in elections is due to Condorcet (1785), but his results were revisited and challenged by recent work in formal political economy, starting with Austen-Smith & Banks (1996). The Condorcet jury theorem states that under fairly general conditions, majority rule will efficiently aggregate beliefs and lead to "good" outcomes if voters vote nonstrategically. Nonstrategic means voters simply vote for the outcome they would choose if they were the only voter.

The key observation by Austen-Smith & Banks (1996) is that in many instances it may be rational for a voter to vote against her own beliefs, because the voter should take into account that other voters may have different information. If that voter knew what the other voters knew, she might want to vote strategically, or possibly abstain.

Two papers explore particularly intriguing applications of this idea. Feddersen & Pesendorfer (1998) show that unanimous jury rules can lead to an extreme form of strategic voting. Suppose a unanimous verdict is needed to convict a defendant. A jury hears evidence, and each juror uses this evidence along with his or her own personal beliefs and experiences to form an opinion about whether the defendant is guilty. Let us suppose that these individual juror opinions are more often correct than not. To be concrete, suppose the probability an individual decision is correct is $q > 0.5$. Ideally, a jury would aggregate these diverse opinions into a verdict that maximizes the probability of a correct verdict (possibly weighting type I and type II errors differently).

What happens if the voting rule is unanimity? If jurors vote nonstrategically, according to their opinion, then the probability the jury will convict if the defendant is guilty equals q^n if there are n jurors. The probability the jury will convict if the defendant is not guilty equals $1–(1–q)^n$. What if voters are strategic? Because this is a voting problem, one juror's decision will only matter if her vote is pivotal. But under this unanimous voting rule, her vote is pivotal only if all other voters vote to convict. But if all other voters are voting nonstrategically, that means *all* of their opinions pointed to a guilty verdict. This swamps the voter's one single opinion, so the optimal strategic response would be to vote "guilty" even if the voter's own opinion is "innocent."

Therefore, it cannot be an equilibrium for everyone to simply vote his own opinion. In fact, the unique symmetric equilibrium where voters vote informatively is to vote to convict with a guilty opinion, but to adopt a mixed strategy and vote to convict with probability $0 < p < 1$ if their opinion is that the defendant is innocent. Moreover, p increases quickly with the size of the jury, eventually converging to 1 for large juries. The algebra and logic of the argument are complicated, and clearly this is not a simple intuition to grasp.

Guarnaschelli et al. (2000) report results from an experiment that tested the game theoretic model of voting in unanimous juries. They found significant strategic voting exactly in the direction predicted by theory. Voters with "innocent" opinions often voted for a conviction, and this tendency increased with the size of the jury. In their experiment, the individual opinions were highly informative, with $q = 0.7$, and the two states (guilty/innocent) were equally likely ex ante. They studied two jury sizes, $n = 3$ and $n = 6$. The experiment also examined behavior in juries that used majority rule rather than unanimity rule but were otherwise identical. In those juries, voters nearly always vote according to their opinion, as theory would predict. Ali et al. (2008) examine the robustness of these results by varying the computer interface, the subject pool, the informativeness of the opinions, the instructions, and some other design features. They conclude that the findings are quite robust. **Table 2** compares the observed frequency of voting to convict by voters with "innocent" opinions, and the equilibrium

Table 2 Percentage of jurors with "innocent" opinions who vote to convict under a unanimous voting rule

N	Opinion informativeness	Equilibrium	Data
3	2/3	32	35
3	7/10	31	36
6	2/3	66	52
6	7/10	65	48

frequencies using the data from Guarnaschelli et al. (2000) and Ali et al. (2008). Voters who believe the defendant is guilty vote to convict with probability close to 100%, as predicted.

A theoretically related but substantively different problem of information aggregation occurs in mass elections. A second paper by Feddersen & Pesendorfer (1996) examines a phenomenon they call the "swing voter's curse." The idea is that less informed voters may abstain from voting in elections, even if voting is costless, because they do not want to cancel out votes by better informed voters who share the same preferences. For example, suppose there are three voters, all of whom share the same state-contingent preferences. If the state of the world is A, they want candidate A to win, and in state B they would prefer candidate B to win. We call such voters "independent" voters, as opposed to partisan voters who would want one of the candidates to win regardless of the state of the world.

Suppose one of the voters is informed of the state of the world, and the other two uninformed voters believe it is state A with probability $\pi = 0.55$. How should the uninformed voters vote? A decision theory approach would say that because $\pi > 1/2$ the uninformed voters should vote for candidate A. If they both abstain, then the election will be decided by the informed voter, so A will win in state A and B will win in state B, which is the optimal outcome. On the other hand, if the uninformed voters vote for candidate A, the outcome is always A, which is only optimal 55% of the time. The unique equilibrium in undominated strategies is for the informed voter to vote and the other two to abstain. If an uninformed voter votes, then he or she will swing the election from A to a tie between A and B if the state is B. This effect is the swing voter's curse. This logic is transparent in this example, but it quickly becomes complicated and unintuitive if we add partisan voters.

Taking the above example, suppose there are two additional voters, both of whom are A-partisans—i.e., voters who prefer and hence will vote for candidate A regardless of the state of the world. How does this change the equilibrium? As before, the uninformed voters would ideally like the single informed independent voter to cast the pivotal vote. However, if they abstain, then the outcome will always be A because there are two A-partisans and only one informed independent. On the other hand, if the uninformed voters vote B (even though it is unlikely to be the "correct" vote), they exactly cancel out the A-partisans, and as a result the single informed independent voter casts the pivotal vote. This is the equilibrium, where the uninformed voters' behavior involves "balancing" in a way that goes in the opposite direction of their prior beliefs about the likelihood of state A.

Battaglini et al. (2008a,b) report experimental results in this kind of asymmetric-information election environment. They test

Table 3 The swing voter's curse: voting behavior by informed independents

N	7	7	7	7	7	7	17	17	17	21	21	21	21	21	21
M	0	2	4	0	2	4	0	6	12	0	6	12	0	6	12
Π	1/2	1/2	1/2	5/9	5/9	5/9	1/2	1/2	1/2	1/2	1/2	1/2	5/9	5/9	5/9
a_{data}	0	6	4	20	12	16	6	4	10	9	20	21	10	11	18
A^*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
b_{data}	8	43	77	7	35	56	7	55	76	9	42	48	2	35	62
B^*	0	36	76	0	33	73	0	42	86	0	33	69	0	32	69
φ_{data}	92	51	19	73	53	28	87	41	13	83	38	31	88	54	21
Φ^*	100	64	24	100	67	27	100	58	17	100	67	31	100	68	31
#obs	217	221	206	404	410	416	135	120	127	151	158	163	304	311	313

(A^*, B^*, Φ^*) are *equilibrium* voting percentages for A, B and Abstain. (a_{data}, b_{data}, φ_{data}) are *observed* voting percentages for A, B, and Abstain. N is the number of independent voters. M is the number of A-partisan voters. π is the probability that A is the state of the world.

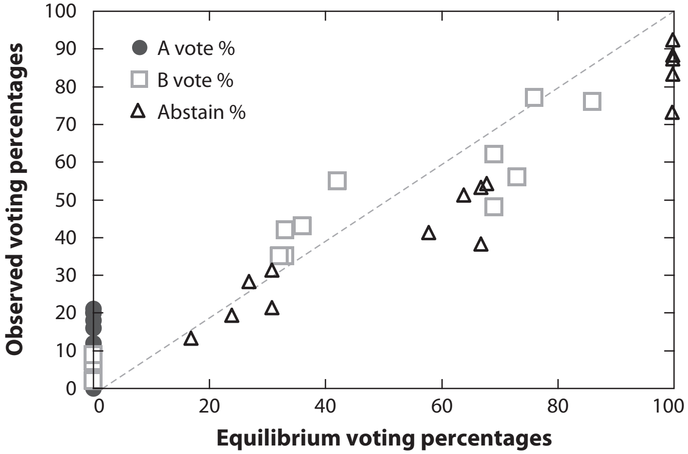

Figure 2

The swing voter's curse: equilibrium versus data.

the swing voter's curse theory in elections with between $N = 7$ and $N = 21$ independent voters, and between $M = 0$ and $M = 12$ (computerized) A-partisan voters. They find abstention and balancing rates that track the theoretical predictions very closely. For example, for $N = 7$, with equally likely states of the world, and a 25% chance that an independent voter is informed, the uninformed independents vote more often for B as the number of partisans increases, and rarely vote for A, as predicted. The two studies include elections where the two states are equally likely ($\pi = 1/2$), and also elections where state A is slightly more likely than state B ($\pi = 5/9$). The robustness of these findings is further explored by using different subject pools. The actual voting behavior of uninformed independents in these laboratory elections is compared with predictions based on the equilibrium voting strategies in **Table 3**. **Figure 2** presents a scatter-plot of the equilibrium and observed voting percentages.

CONCLUDING REMARKS

This article has only given a glimpse of some of the most recent experimental work in political economy, and it cannot do justice to the wide range of laboratory experiments in this area. However, just from these examples, four tentative conclusions emerge. First, across three very different voting settings (voter turnout, jury decision making, and elections with the swing voter's curse), the evidence points overwhelmingly to highly strategic behavior by voters. Second, the observed behavior is consistent with the fundamental idea in game theoretic models of voting that behavior is determined to a large extent by "pivotal voter calculus." Mathematically, this calculus is complicated and difficult to solve—sometimes impossible to solve for a Nash equilibrium, analytically. Intuitively, the pivotal voter calculus requires the cognitively difficult task of conditioning on hypothetical (pivotal) events, rather than just taking simple expectations or making decisions based on prior beliefs. Strategically, optimal decisions in these game theoretic environments may require voters to think about how other voters make choices, and Nash equilibrium requires these conjectures to be accurate. For these reasons, many of the choice behaviors predicted by the equilibrium theories seem implausible, which makes their empirical validation in the laboratory quite surprising. Third, nearly all the comparative static predictions of the strategic voting theories hold up in these experiments. Fourth, there are some quantitative differences between laboratory data and game theoretic predictions (e.g., turnout higher than predicted when there are many voters) that mirror observations in the field and are suggestive of possible theoretical explanations.

This combination of findings is consistent with other political economy experiments this survey has glossed over for reasons of space. Experiments on multicandidate elections (Forsythe et al. 1993, 1996) provide support for theories of strategic voting, and for the critical role of polls in solving the coordination problem inherent in three-candidate winner-take-all races. The early experiments that apply cooperative game theory to open committee bargaining experiments find considerable support for solution concepts, in particular the majority-rule core (Fiorina & Plott 1978, Kormendi & Plott 1982). However, by stressing the theories with very challenging environments, one can observe systematic departures from the theoretical predictions (Eavey & Miller 1984, McKelvey & Ordeshook 1981). These departures provide insights for alternative theories.

Laboratory experimentation has a bright future in political economy, particularly in the testing of formal theoretical models. It is still a relatively new methodology to political science, and many interesting possibilities have still not been explored. One that seems particularly promising is to scale up the laboratory study of elections by conducting controlled experiments via the Internet. It should now be feasible to conduct experimental studies in the political economy tradition using committees or electorates orders of magnitude larger than have so far been studied in laboratories. Issues of logistics, design, and control will need to be confronted when scaling up in numbers and when conducting experiments remotely rather than locally, but with some effort (and experience) it should be possible to resolve these issues.

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