An Experimental Investigation of Electoral College Contests

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Preliminary draft

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Abstract: The Electoral College system used to elect the President of the United States is an example of a multi-battle contest with complementarities. Because of heterogeneity in the value of the different state level sub-contests, many different combinations of state victories can lead to an overall victory which impacts contestant strategy. This paper develops theoretical predictions for a simplified four state Electoral College map when states are awarded via a Tullock success function and tests those predictions using controlled laboratory experiments. We use three different Electoral College maps in which the number of total votes is always the same. Our experimental results show that subjects behave quite differently from theoretical prediction. Instead they seem to be using a mental accounting rule according to which they choose to spend half the value of the prize as their budget in the lottery success function. They depending on the map, they follow different bidding patterns with bidding on a minimal number of states being the most predominant pattern.

Keywords: Contests, Multibattle Complementarities, Electoral College, Experiments

JEL Codes: C7, C9, D7

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1. Introduction

Contests have been used to model a wide range of activities from elections to lobbying to patent races (Krueger, 1974; Tullock, 1980; Fudenberg et al., 1983; Haris and Vickers, 1985, 1987; and Synder 1989). Within this literature, much attention has been given to multi-battle contests where the overall winner is determined by the outcome of a set of sub-contests (see Konrad 2009; and Kovenock and Roberson 2010). An example of such a multi-battle contest is the Electoral College that is used to determine the US President. Candidates compete in each state (and the District of Columbia but not in US territories such as Puerto Rico and Guam) for delegates. The number of delegates in a state is based on its number of members in Congress. The number of delegates ranges from 3 in less populated states like Delaware and North Dakota up to 55 in California. In total there are 538 delegates and whoever claims a majority of delegates wins the election.

While the literature on multi-battle contests goes back to Borel (1921) and Borel and Ville (1938) (see also Gross, 1950; Gross and Wagner, 1950; and Freidman, 1958), most of the previous work on multi-battle contest has used a simple majority of the sub-contests rule. In a presidential US election this would be akin to each state having one delegate. More recently, there has been more interest in other rules. For example, Clark and Konrad (2007) and Golman and Page (2009) consider a weak-link structure where one contestant needs to win a single battle to be victorious while the other needs to win all of the battles. Szentes and Rosenthal (2003a, b) consider a more general case where one party needs to win some specified fraction of the battles in order to be the overall winner.

Still, in most of the existing literature and unlike the Electoral College, the individual battles are interchangeable.[1] One exception to this norm is Kovenock, et al. (2012) who consider a contest for a set of geographic regions where there are complementarities between some adjoining regions. Specifically, they explore the game of Hex in which two players are attempting to win combinations of battles in order to form a particular pattern when the regions are viewed on a map. Kovenock, et al. (2012) assume that each region is allocated according to a Tullock contest success function and show that players should place positive bids for every region in equilibrium as each region is part of some winning combination. Further, regions that have more strategic value, as they are in more winning combinations, should receive higher bids. Deck, et al (2016) design an experiment to test the predictions of Kovenock, et al. (2012). While the behavioral results are largely consistent with the theoretical model in aggregate, they conclude that the model does not capture strategic behavior in the game. Instead, subjects tend to compete on minimal winning sets

[1] If the battles occur in sequential order, then the strategic incentives for the battles may differ, but it is still the case that the identity of the battle does not matter, only its order in the sequence.

of regions, combinations of regions that are sufficient for victory but such that no proper subset would be.

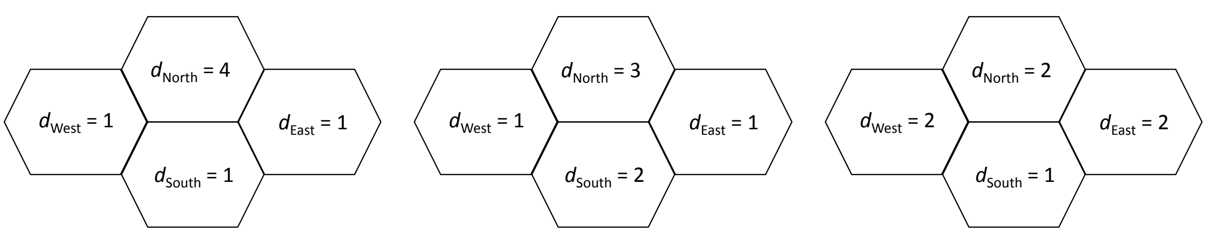
This paper extends the model of Kovenock, et al. (2012) to an Electoral College contest. By varying the distribution of the delegates across regions, the strategic relevance of the different regions and hence the equilibrium bids for each regions changes. In particular, two different regions can have the same strategic value even though they have are worth different numbers of delegates. Further, the strategic value of a region can change if delegates are reallocated among other regions. Finally, the total expenditure is expected to vary with the allocation of delegates. This paper also presents the results of laboratory experiments that test the theoretical predictions. As a prelude to the results, players appear to generally bid either on a minimal winning set or proportionally on regions based on the number of delegates, with relatively few players choosing optimal strategies.

2. Model and Hypotheses

Two risk neutral players R and D, compete for a common prize V by claiming states to earn delegates. The set of states is S = {North, West, East, South} and the number of delegates in state s S is d_s. States are claimed via a standard Tullock contest. Let R_s and D_s denote the amount that players R and D spend campaigning in state s, respectively. The probability that player R claims state s is $\frac{R_s}{R_s+D_s}$, with the probability that player D claims the state defined similarly. If player R wins state s then player R receives d_s delegates. Player R wins the prize V if she receives a majority of the contested delegates and otherwise player D wins the prize. For simplicity, it is assumed that $\sum_s d_s$is odd.

Depending on the number and distribution of delegates, different sets of states can constitute winning combinations. For convenience, the vector *m* = {d_{North}, d_{West}, d_{East}, d_{South}} is referred to as an Electoral College map or simply a map. Figure 1 shows three distinct maps where $\sum_s d_s$ = 7. In fact, up to relabeling, these are the only possible maps with seven delegates in four regions where each region has at least one delegate.

Figure 1. Electoral College Maps



(4,1,1,1) (3,1,1,2) (2,2,2,1)

Let M* denote the set of winning sets for map m. Notice that the set of winning sets is the same for both players and in any allocation of states exactly one player will be the winner. A minimum wining set is an element of M* such that no proper subset of it is also in M*. The minimal winning sets for each map shown in Figure 1 are presented in Table 1.

Table 1. Theoretical Predictions by Map when a Win is Worth V

Map	**(4,1,1,1)**	**(3,1,1,2)**	**(2,2,2,1)**
Minimal Winning Sets	{North}	{North, West}, {North, East}, {North, South}, {West, East, South}	{North, West}, {North, East}, {West, East},
Equilibrium Investment			
North	V/4	3V/16	V/8
West	0	V/16	V/8
East	0	V/16	V/8
South	0	V/16	0
Total Investment	V/4	3V/8	3V/8
Expected Profit	V/4	V/8	V/8

The probability that R wins the contest with map m is $P = \sum_{\mu \in M} \left[\prod_{s \in S \cap \mu} \left(\frac{R_s}{R_s + D_s} \right) \prod_{s \notin S \cap \mu} \left(\frac{D_s}{R_s + D_s} \right) \right]$. By assumption, all spending is forgone regardless of who wins the election. Thus player R's profit function is given by $VP - \sum_{s \in S} R_s$. Player D's optimization problem is similar. For a given map, the optimal response is straightforward to calculate as profit is a continuous function in four variables. Thus, the equilibrium investments can be derived from the four first order conditions for each player.[2] Table 1 provides the equilibrium investments for the three maps shown in Figure 1.

In (4,1,1,1), the minimum winning set is {North}, so a player will win the election if she claims the delegates in North and the outcome in each of the other states is irrelevant. The result is that the contestants should ignore everything beside North and act as if they are in a standard Tullock contest. Hence they should invest V/4 in North and invest 0 elsewhere. For (3,1,1,2) it turns out that South is strategically equivalent to East and West despite being worth more delegates. A player can win by claiming North and one of the other three states or by claiming everything but

[2] The model follows that of Kovenock, et al. (2012) and Deck, et al. (2016) and the interested reader is referred to those papers for more details. The difference pertains to the construction of the set of winning sets. In those papers the set of winning sets or each player differs whereas M* is common in the Electoral College setting.

North. The result is that a player should invest three times as much in the North as in the other regions. For the (2,2,2,1) map, it turns out that South is not in any minimal winning set and thus in equilibrium it should be ignored. The other three states are symmetric with a player needing to claim any two of the three to be victorious.

The equilibrium predictions for these three maps reveal several noteworthy results. The first is that the strategic value of a state is not solely a function of its number of delegates. The second is that on a map the strategic value of a state is not a strictly monotonic function of its number of delegates. Finally, despite the fact that the maps all have the same total number of delegates, the total investment is not constant. Since each player places the same bid, in equilibrium each expects to win half the time and generate revenue of V/2 and as a result the expected profit can vary (see Table 1).

3. Experimental Design

To test the predictive success of the equilibrium analysis presented in section 2, a within subject experimental design was used. In groups of ten, subjects entered the lab, read a set of instructions (available in the appendix along with a summary statement that was read aloud), and then participated in a series of election contests. Subjects completed three blocks of 10 contests, using a different map in each block. Subjects were randomly and anonymously matched at the start of each contest. After a contest was completed, the subjects observed the outcome in each state and their own profit, but not the investment or profit of their counterpart. Data were collected from six groups of subjects and each group experienced the three maps in a unique sequence to control for order effects. Subjects were not informed of how many contest they would complete with a given map or the number of maps they would face.

In each contest, the prize for claiming the most delegates was V = 48. The numeric predictions for each map are given in Table 2. However, previous experiments have consistently found that subjects bid approximately twice the equilibrium value or alternatively half the prize amount in a standard Tullock auction (see Dechenaux, et al. 2012). Further, the results of Deck, et al. (2016) suggest that subjects facing a contest with complementarities behave as if they are using a two stage rule of first the bid amount which equals half the value of the prize and then deciding how to allocate it across the different contests. Taking this behavioral pattern into account leads to the behavioral predictions shown in Table 2. For example, in (3,1,1,2) North is in three minimal winning sets each containing two states. If subjects follow the same behavioral pattern as in Deck, et al. (2016) then the average investment in North would be ¾(12)+¼(0) = 9, while the average investment in South would be ¼ (12)+¼(8)+½(0) = 5. While the standard theoretical model and the behavioral hypotheses generally lead to different predictions, both approaches predict the same investment in North for the (3,1,1,2) map and in cases where the state is not part of a minimal winning set.

Table 2. Theoretical and Behavioral Predictions

Map	**(4,1,1,1)**		**(3,1,1,2)**		**(2,2,2,1)**	
	Theoretical	*Behavioral*	*Theoretical*	*Behavioral*	*Theoretical*	*Behavioral*
North	12	24	9	9	6	8
West	0	0	3	5	6	8
East	0	0	3	5	6	8
South	0	0	3	5	0	0

Each subject received a participation payment of $5 for the one hour experiment, as is standard in the Economics Laboratory at the University of Alaska-Anchorage where the experiment was conducted. In the experiment, all monetary amounts were denoted in Lab Dollars. Subjects began a session with a balance of 150 Lab Dollars to which their profits and losses in each election were added. At the end of the experiment, Lab Dollars were converted into US dollars at the rate 25 Lab Dollars = 1 $US. The average payment in the experiment was $11.22.

4. Experimental Results

The results are presented in two subsections. The first examines aggregate behavior while the second looks at individual bidding strategies.

Aggregate Behavior

Aggregate behavior is summarized in Table 3.[3] Several interesting patterns emerge from this table. The first is that in every case the average observed bid exceeds the theoretical prediction. In the four cases where a state is never part of a minimal winning set (the predicted bid is 0), several subjects do place positive bids on average, but these bids are relatively small and it is important to keep in mind any bidding error is necessarily one-sided.[4] Note that for the eight cases where a state is part of a minimal winning set, bidding errors are two-sided. Thus, the probability that all eight such cases have observed bids above the theoretical prediction is only $\frac{1}{2^8}$ = 0.004, if people are bidding according to the theoretical model. By contrast, the observed bids are only above the behavioral predictions in five of the eight cases. The probability of observing

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[3] Recall that subjects experienced each map 10 times. The results are qualitatively unchanged if attention is restricted to the last half of the observations.

[4] Because bids were restricted to be non-negative, when the prediction is 0 errors can only be positive, thus any random error will lead to observed bids being greater than the prediction.

an outcome this or more extreme is 0.727 if people are following the behavioral predictions and making random errors. Thus, the aggregate behavior is generally consistent with the behavioral model and not the theoretical model.

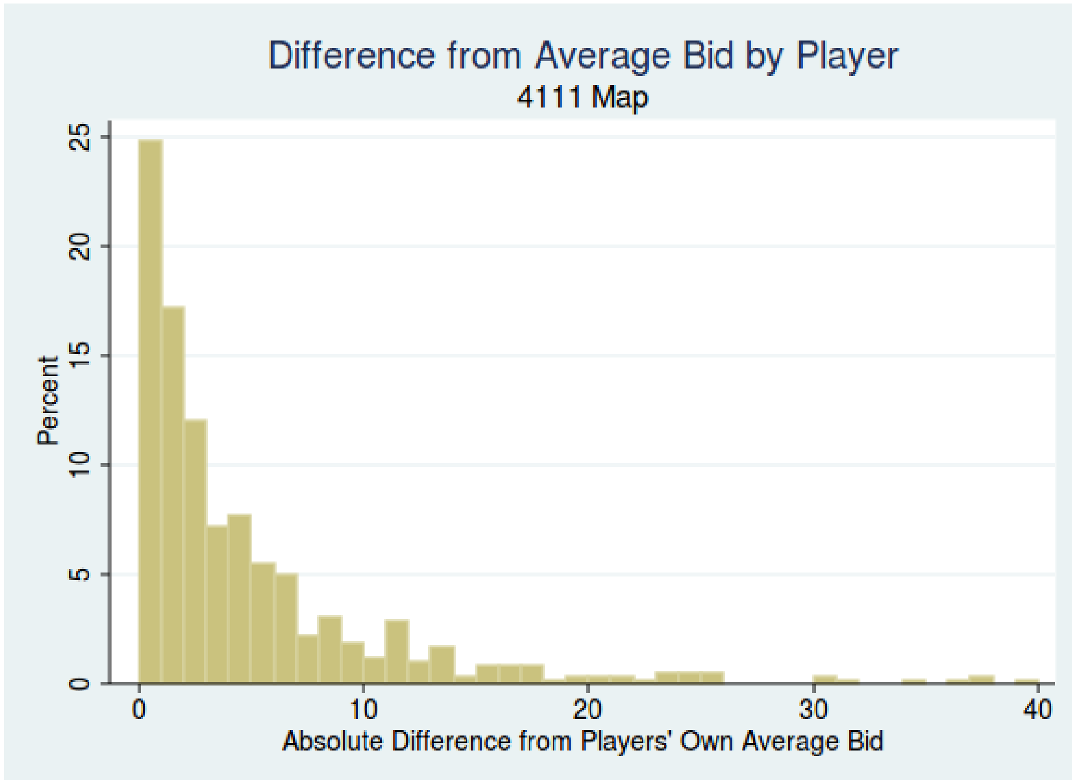
Table 3. Mean and Standard Error of Observed Behavior

Map	**(4,1,1,1)**	**(3,1,1,2)**	**(2,2,2,1)**
North	21.47 (1.67)	11.60 (0.95)	8.41 (0.61)
West	1.62 (0.31)	4.11 (0.41)	6.60 (0.50)
East	1.78 (0.37)	4.54 (0.42)	7.94 (0.58)
South	1.57 (0.34)	6.22 (0.56)	2.60 (0.53)
Total	26.44 (1.55)	26.43 (1.58)	25.54 (1.52)

Averages are based on n = 600 bids. Standard errors are clustered at the subject level.

Table 3 also reveals that for six of the seven cases in which the theoretical and behavioral predictions differ (see Table 2), the observed behavior is closer to the behavioral prediction than the theoretical prediction.

A final pattern that emerges from Table 3 is that total spending is nearly identical in the three maps. This is also supported by regression analysis where an indicator variable is included for each map and standard errors are clustered at the subject level. An F-test fails to reject that the coefficients for three maps differ (p-value = 0.701). The similar spending levels and the superior performance of the behavioral predictions are suggestive of subjects not behaving according to the theoretical model, rather they seem to be following some the type of mental accounting suggested in Deck et al. (2016). This procedure implies that subjects first select a bid amount and then decide how to allocate it to obtain a majority of sets. The following three graphs show that in each map, subject's bids are not very different from the average bid for that map. In fact in all three cases, the vast majority of the bids are tightly clustered around 0, suggesting that most players are consistent in their bidding behavior. Note that this behavior is most pronounced in the (3,2,1,1) map. Keeping this in mind we now move to the analysis of individual behavior.


Difference from Average Bid by Player
4111 Map
Percent
0
5
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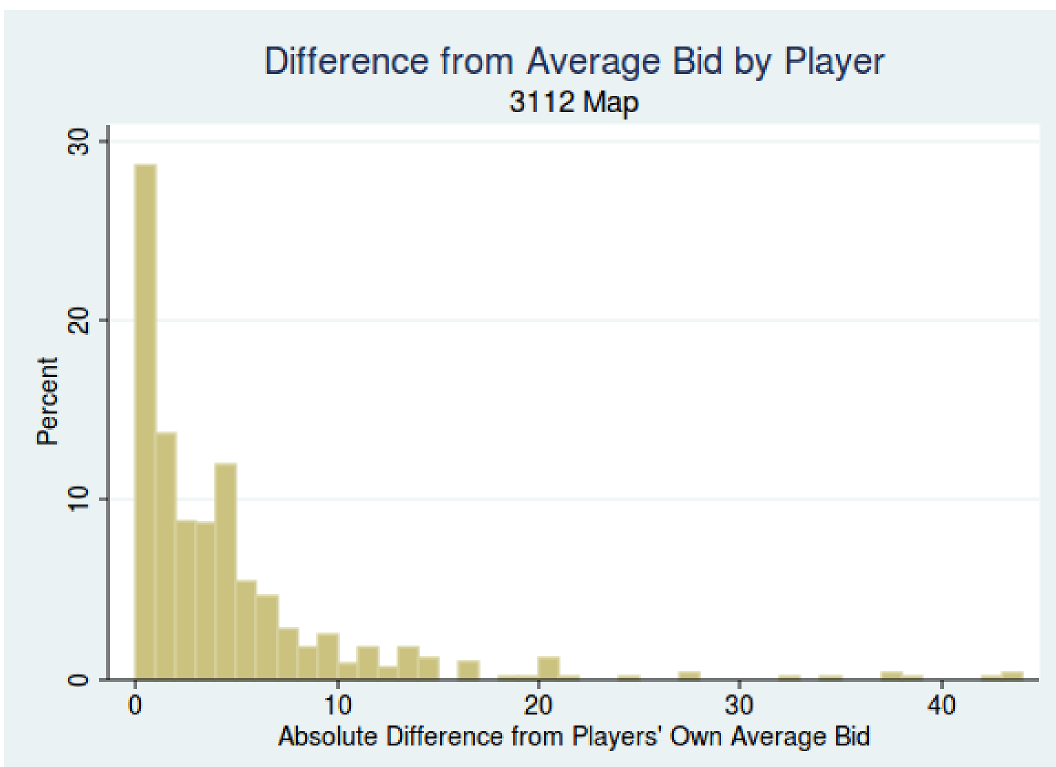
Absolute Difference from Players' Own Average Bid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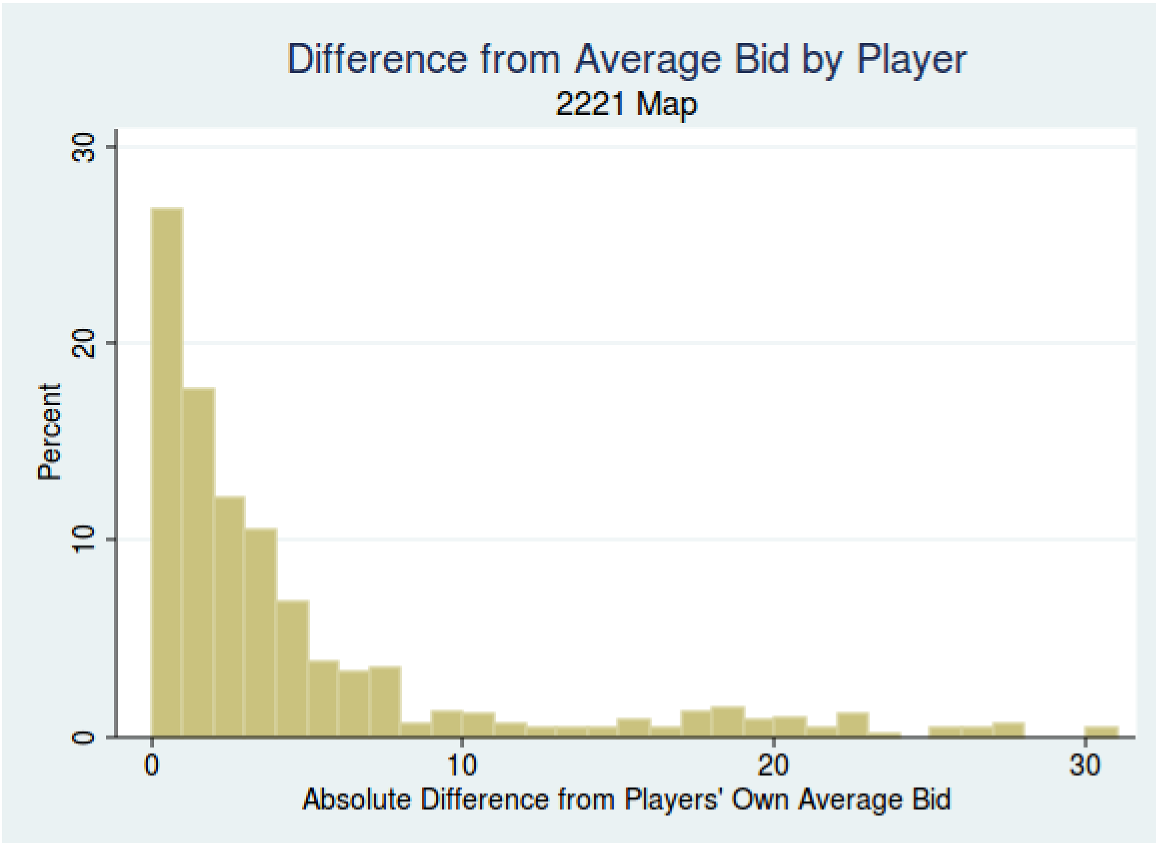

Individual Behavior

We examine individual bidding behavior in two ways. First, we will study the spatial pattern of bidding in the three different maps ignoring the magnitude of the bids placed on each state. Then we study the bid magnitudes for each state in the three maps.

We begin by classifying strategies using the pattern of positive bids placed in each map. This can construed as a means to check what the intended behavior is, assuming that subjects may not be using the correct positive values for the bids. For the 4,1,1,1 case, both the Nash equilibrium and the minimal winning set consists of placing positive bids only on the region with value 4. In the 3,1,1,2 case, the Nash equilibrium consists of bids positive placed everywhere, while minimal winning sets consist of positive bids on two regions including the value 3 region, or the three other regions. Finally, in the 2,2,2,1 case, the Nash equilibrium consists of positive bids on all three regions of value 2, while a minimal winning set consists of positive bids two of these regions.

Subjects bidding information is shown in Table 4. In this table "*Everywhere*" implies that subjects placed a bid on all 4 regions, while "*Nash*" implies that subjects placed bids only on regions supported by the Nash equilibrium. "*Minimal*" refers to bids placed only on allowable minimal winning sets, while "*Zero*" implies that the subjects did not place a bid at all. All other bidding patterns are classified as "*Other*."

Table 4. Classifying bid types by their spatial pattern (in percentage terms)

Type	**4,1,1,1**	**3,1,1,2**	**2,2,2,1**
Everywhere	38.3	60.8	50.3
Nash	45.8	60.8	23.7
Minimal	45.8	21.7	13.8
Zero	4.7	6.0	6.0
Other	11.2	11.5	6.2

Given these breakdowns, a natural question is whether individual subjects have a strong preference for particular type of strategy. *In other words, the question is do we have different types of players?* We find that within a map, subjects tend to keep playing the same strategy 86% of the time after winning money in the previous round. Moreover, if they lose in a particular round, only 32.3% of the subjects change their strategy with some of them switching to a different strategy but of the same type. However, there is little evidence of players choosing the same strategy between maps. Allowing for the possibility of one or two mistakes, there are only 10 subjects who play "*Everywhere*" on all three maps, and only 2 who consistently choose the Nash strategies. *Based on these findings, we do not think that there is an inherent player type, rather subjects are choosing a strategy for each map*; these players do vary this choice somewhat, doing so more frequently after losses.

We now move on to analyzing the magnitude of the bidding strategies in each map. In order to do this we first define three reference points. The first of these will be called *Nash* (**N**) bidding and the number for each of the three maps can be found in Table 2 under the column labeled "Theoretical". Our next reference point is called *Minimal* (**M**) which implies bidding on the minimal number of states needed to obtain majority. In the map (4,1,1,1) when we do not examine magnitudes, minimal coincides with behavioral – subjects should bid only on the state valued at 4. However, when we look at magnitudes, as a reference point, our minimal strategy will use the values given in Table 2 under the column "Behavioral." Hence the Nash strategy for the (4,1,1,1) map is bidding 12 while the Behavioral one is bidding 24 on the state valued at 4 and zero on all the other three states. Note that the numbers listed under the behavioral column list the average bid on each state. It does not require subjects to bid on all of them. In other words, for the (2,2,2,1) map, our minimal strategy will consider situations where the players bid on any two states valued at 2, and will use the value 8 given by the Behavioral column instead of 6 under the Theoretical column. Finally in this section we also consider a third reference strategy called *Proportional* (**P**) bidding. This is the analogue of the "Everywhere" strategy in Table 4 and assumes that subjects bid in proportion to the value of the state. To obtain these values, we will used the implicit budget of 24 suggested by the mental accounting rule identified earlier. Hence the proportional bid for the (4,1,1,1) map is given by (4?(24/7), 24/7, 24/7, 24/7) and for the (2,2,2,1) map by (2×(24/7), 2×(24/7), 2×(24/7), 24/7). The value for the (3,2,1,1) map can be computed similarly.

Next we sort each bid of each subject for the three different maps into one of these three categories. In order to do this, we take the subject's bid value in every round for a given map and compute its Euclidean distance from the **N**, **M** and **P** points defined above respectively. The observed bid is then sorted in to one of these three types based on the point to which it is the closest in distance terms. This exercise is repeated for all three maps. A number of zero bids are also observed. These are recorded separately since they cannot be matched to any strategy. This information is presented in Table 5.

Table 5. Classifying bid types by their magnitudes (in percentage terms)[5]

Closest Pattern	**4,1,1,1**	**3,1,1,2**	**2,2,2,1**
Nash	11.2	10.2	17.5
Proportional (=Everywhere)	19.2	23.0	31.0
Minimal (= Behavioral)	53.2	51.0	35.2
Zero	18.2	16.5	18.7

[5] The percentages on the table are whichever strategy's point is closest. There are a few cases where there are equally close strategies, thus the percentages add up to slightly more than 100%.

For the (4,1,1,1) map, Nash equilibrium and the minimal strategy coincide in terms of the state subjects should bid on (Table 4), but differ in the magnitude. We find that over half the subjects bid according to the behavioral strategy, with only 11.2% bidding according to the Nash equilibrium. However, there a few observations consistent with bidding in proportion to the weight of the state, but comparing the numbers for this in Tables 4 and 5 it is clear that bids being placed on the other areas must be very small.

In the (2,2,2,1) map, Nash equilibrium and minimal bidding require different strategies. It is again clear that only a few subjects bid according to the Nash equilibrium. A third of the subjects also bid on the all four states, again suggesting that subjects do not fully understand the strategic implications of the weights of each state. However, observe that in the (4,1,1,1) map this is a much lower number since in that map it is easier to realize that states valued at 1 cannot help attain majority. Moreover, comparing with Table 4 suggests that the bids on the fourth region are small. Once again we find that over a third (35.2%) of the subjects place bids that are minimal.

For the (3,2,1,1) map, Nash equilibrium and the Proportional strategy coincide in terms of the state subjects should bid on (Table 4), but differ in the magnitude. Once again the minimal strategy with just over half the bids seems to be the most popular strategy in this map, with only a small number of observations that can be classified as Nash bidding. The evidence for our mental accounting rule also seems to be stronger here since 23% of the subjects seem to be bidding everywhere, but using 24 as their budget instead of 18 suggested by the Nash strategy. Interestingly, when following the minimal strategy, the subjects appear bidding mostly on North (value =4) and West (value =1) and North and East (value =1) although South (value = 2) is strategically equivalent. This is indicative of greater support for the minimal strategy, because these two minimal winning sets have either a smaller number of states or lower total weight as the other minimal wining sets and are thus perceived as being easier to obtain. Another pattern that is also clear here is that rather than splitting their bids equally over the states for which a positive bid is placed, in (3,1,1,2) subjects appear to be allocating money among the states for which a positive bid is placed in proportion to the weight of the state suggested by the Behavioral column in Table 2.[6]

As we would expect, players are much more likely to switch strategies after losses. Overall, players switch strategies 20.2% of the time between observations on the same map, with switches occurring 28.3% of the time after losses and 12.6% of the time after wins. Switching behavior does become less common in later rounds on each map, suggesting that players are more uncertain about their choices early on.

[6] For (2,2,2,1) this distinction is not relevant because the all states in a minimal winning set have an equal number of delegates.

In the 2,2,2,1 map, we see a significant increase over time in the frequency of bids which we classify as the zero strategy, with such bids occurring 15.4% of the time in the first half of the periods, and 22.5% of the time in the second half. This frequency does not noticeably change in the other maps. This may be due to the popularity of players choosing a minimal winning set, as there are 3 equally obvious choices in the 2,2,2,1 map, which may lead players to give up.

One other natural question is if player strategies are influenced by the previous map they played on. However, we find no such ordering effects in our data. Players do appear to treat each map as a separate game with little, if any, carryover from the previous maps.

5. Concluding Remarks

In this paper we develop a model of Electoral College competition based on the lottery success function without an explicit budget making it different from work on stochastic Colonel Blotto games. Since the different states have different weights, our paper is closer to the literature on asymmetric Blotto games. It also relates to the work of Kovenock et al. (2015) and Deck et al. (2016) on contests with complementarities. The theoretical predictions are then tested in the lab. There is strong evidence that the majority of the subjects in the experiment do not make Nash equilibrium bids. This is not simply due to the typical over bidding frequently observed in experiments, but primarily due to a mental accounting procedure by which subjects seems to be choosing to bid half the value of the prize in the contest. This is then allocated to minimal winning sets. Thus subjects seems to differ from theory along in contests involving lottery success functions and majority voting in two dimension – in terms of how much to spend in winning and how to allocate it on different states. This provides valuable insights about Electoral College behavior since out laboratory set up does not have the deficiencies present in the empirical data on campaign spending.

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Appendix

Subject Instructions

This is an experiment about the economics of decision making. You will be paid in cash at the end of the experiment based upon your decisions, so it is important that you understand the directions completely. Therefore, if you have a question at any point, please raise your hand and someone will assist you. Otherwise we ask that you do not talk or communicate in any other way with anyone else. If you do, you may be asked to leave the experiment and will forfeit any payment.

The experiment will proceed in three parts. You will receive the directions for part 2 after part 1 is completed and for part 3 after part 2 is completed. What happens in part 2 does not depend on what happens in part 1, and what happens in part 3 does not depend on what happens in part 1 or 2. But whatever money you earn in part 1 will carry over to part 2 and whatever you earn in part 2 will carry over to part 3.

Each part contains a series of decision tasks that require you to make choices. For each decision task, you will be randomly matched with another participant in the lab. None of the participants will ever learn the identity of the person they are matched with on any particular round.

In each task you have the opportunity to earn Lab Dollars. At the end of the experiment your Lab Dollars will be converted into US dollars at the rate $25 Lab Dollars = $US 1.

You have been randomly assigned to be either a "**Green**" or a "**Yellow**" participant. You will keep this color throughout the experiment. For every task you will be randomly matched with a person who has been assigned the other color. Your color is indicated in a box on the lower part of your screen. This portion of your screen also shows you your earnings on a task once it is completed and your cumulative earnings in the experiment. You will start off with an earning balance of **$160.**

You and the person with whom you are matched are facing each other in an election. In the center of your screen you can see a map with four regions: North, South, East, and West. Each region has an associated number of delegates as will be shown on the map with a number beside a "D". If you win a region you claim all of the delegates from that region. The person who wins a majority of the delegates on the entire map wins the election and receives a payment of **$48**. Since there are always a total of 7 delegates, anyone who wins 4 or more delegates wins the election. This map will not change during this part of the experiment.

You and the person you are matched up with have to decide how much to spend campaigning in each of the four regions. Any amount you spend on a region is deducted from your earnings regardless of whether or not you win the region. Since you have to pay what you spend, the sum of your campaign spending in the four regions cannot exceed the payment you would receive if you win, **$48**.

Claiming the delegate in a region works in the following way. The chance that you claim a region is proportional to how much you spend campaigning in the region relative to the total amount spent for that region. For example, suppose that **Yellow** spends $6 for the North and **Green** spends $2 for the

North then the chance that **Yellow** would claim North is 6/(6+2) = 6/8 = 75%. The chance that **Green** would claim North is 2/(6+2) = 2/8 = 25%.

As another example, suppose that **Yellow** spends $0 for the North and **Green** spends $0.25 for the North then the chance that **Yellow** would claim North is 0/(0+0.25) = 0%. The chance that **Green** would claim North is 0.25/(0+0.25) = 100%.

If both parties spend $0 then each would claim the region with a 50% chance.

You and the person you are matched with will both privately and simultaneously determine your spending for all four regions at one time. The computer will then determine who claims each region based upon the probabilities associated with the spending. Each region will turn **Yellow** or **Green** to indicate who claimed the delegates in that region.

Summary Announcements

1. You receive the prize of 48 only if the total number of delegates in the set of regions you claim is at least 4. It does not matter how many regions you claim, only how many delegates you have.

2. The chance you claim a region is equal to the proportion of your bid on the region to the total amount bid on that region. For example, if you bid 10 and the other person bids 20 then you have a 1/3 chance of claiming the region and the other person has a 2/3 chance of claiming the region.

3. Any amount you bid is automatically deducted from your earnings, regardless of whether or not you receive the prize of 48. For example, if your four bids sum to 40 and you receive the prize you will earn 8 because you will earn the prize of 48 – 40 in bids, but if you do not receive the prize you will earn – 40.

4. The sum of your bids cannot exceed 48.

5. You must enter a numeric bid for each region. If you want to bid 0 for a region you must type in a 0, you cannot leave it blank. Bids can have up to 2 decimal places.

6. If you press the submit button and it does not disappear, then your bids have not been submitted. In this case you need to make sure that you have entered a numeric bid for each region, that each bid is non-negative, and that the sum does not exceed 48.

7. Each round you are randomly matched with someone in the experiment. So there is a chance that you interact with the same person two times in a row, but it is unlikely.

Any questions before we begin?