Does deceptive advertising reduce turnout? Theory and laboratory evidence

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Abstract

We consider two-candidate elections in which voters are uncertain about candidates' qualities and candidates can inform voters of their quality by sending advertisements. We compare campaigns where advertising must be true to campaigns with deceptive advertisements in which the low quality candidate falsely claims to be high quality. Voting is voluntary and voters have no cost of voting. In our environment we demonstrate Bayesian Nash equilibria which imply that voter turnout is lower in campaigns where deceptive advertising is possible. We proceed to conduct laboratory elections, and observe that participation among voters who receive an advertisement is high, but lower in treatments where deceptive advertising is possible. Moreover, efficiency of the electoral outcome is much lower in treatments with deception. Implications of our results for voter participation in naturally occurring democratic elections are discussed.

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1 Introduction

The information level of voters has a substantial impact on voting behavior. There is much evidence that a higher level of voter information increases participation in the electoral process. Theoretical models predict that an increase in overall information increases turnout (e.g. Matsusaka 1995, Feddersen and Pesendorfer 1999). Recent empirical studies by Gentzkow (2005) and by Lassen (2005) show that turnout is positively affected if voters have more information (as they read newspapers or receive detailed information about the choices in a referendum).[1] Moreover, data from a laboratory experiment by Houser et al. (2008) provides supportive evidence that informative campaign advertising increases turnout.

In naturally occurring elections it often turns out that information which is provided during electoral campaigns is actually false. A recent example is Hillary Clinton's (false) claim that there was an attack when she arrived in Bosnia 1996. Her intention for this claim was seemingly to signal her competence in foreign policy. There are many other examples of false information that is provided during electoral campaigns to attract voters like tax reduction promises that are not kept or statements about thinkable and unthinkable coalition partners that are disregarded in the end. Compared to the provision of truthful information, voter behavior might differ when information can be deceptive. Voters may for example abstain or become protest voters. Hence, it is important to distinguish between the provision of truthful and deceptive information when analysing the effect of information on voter behavior. So far, there is no empirical study that considers the effect of deceptive – compared to truthful – information on voting behavior. The aforementioned studies either cannot/do not identify whether the information people receive is truthful or as in the case of Houser et al. (2008) explicitly assume that advertising is truthful. In Battaglini et al. (2007) and (2008), voters receive signals that either provide them with perfect information or that are fully uninformative but they do not consider the possibility

[1] Also Coupe and Noury (2004), Palfrey and Poole (1987), and Wattenberg et al. (2000) find a positive correlation between turnout and information levels but in these studies it is difficult to establish a causal link.

of false information.[2]

In this paper, we analyze the effect of advertisements that are either truthful or can be false on voter behavior, turnout, and the efficiency of the electoral outcome theoretically and in a laboratory experiment. We consider two-candidate elections in which voting is voluntary and there are no costs of voting. Candidates represent their party and can be of either high or low quality, their qualities being perfectly negatively correlated. The quality of the elected candidate effects the utility of all voters. All voters prefer a high quality candidate to a low quality candidate – irrespective of the candidate's party affiliation. Yet, voters differ in their preferences for a given quality of the candidates: half of them lean towards the one party, the other half towards the other party. We say that voters are affiliated with one of the parties. Voters are uncertain about the candidates' qualities but may receive signals about candidates' qualities that are either perfectly informative or noisy.[3] We demonstrate that in truthful campaigns two symmetric pure strategy equilibria are possible. Either all voters vote in equilibrium; the ones who received an advertisement vote for the high quality candidate and the ones who did not receive an advertisement for the candidate of the party they are affiliated with. Or, in the other equilibrium, only voters who received an advertisement vote while those who did not receive an advertisement abstain. If the probability of receiving an ad is sufficiently small, only the first ("all vote") equilibrium exists, if it is sufficiently large, only the latter ("abstention") equilibrium exists, and for the intermediate range both exist. For campaigns, in which advertisements can be deceptive, we demonstrate that only the equilibrium in which uninformed voters abstain and informed voters vote for their own party's candidate exists – at least for the parameter values that we use in the experiment.

The design of the entirely computerized experiment follows the above setup. Subjects participate in 40 laboratory campaigns and elections. During campaigns, subjects may receive advertisements. After the campaign, subjects

[2]These studies build on the swing voter's curse literature, e.g. Feddersen and Pesendorfer 1996.

[3]Our model is most closely related to Feddersen and Pesendorfer (1999).

decide for which party to cast their vote or whether to abstain – having received an advertisement or not. Subjects participate in two treatments: Either advertisements are truthful or advertisements can be deceptive, i.e. the low quality candidate claims to be of high quality. Subjects are informed whether advertisements are truthful or not and know the probabilities of receiving an advertisement. In deceptive campaigns they also know the probability that the advertisement is actually false. Our results indicate that deceptive advertising strongly affects voting behavior. We observe that participation among voters who receive an advertisement is high, but lower in treatments where deceptive advertising is possible. Moreover, efficiency of the electoral outcome is much lower in treatments with deception, i.e. the low quality candidate is elected more often in deceptive campaigns.

In the following, we first introduce our election model and derive the symmetric equilibria in Section 2. Then, in Section 3, we present our experimental design. In Section 4, we summarize the theoretical predictions for voter behavior and efficiency of the electoral outcome. In Section 5, we present our results and we conclude in Section 6.

2 The Model

We consider two-candidate elections: There are two parties, the Circle party ($\bigcirc$) and the Triangle party ($\triangle$). Each party is represented by a candidate. Candidates have fixed ideologies reflecting their parties' positions. In addition to their party affiliation, candidates are characterized by their types or qualities which are either "high" (H) or "low" (L).
The population consists of N (potential) voters. All voters are swing voters. Voters differ in the sense that half of them lean towards the Circle party, the other half towards the Triangle party. Yet, voters preferences are homogeneous with respect to candidate quality: They prefer a high quality to a low quality candidate irrespective of the candidate's party affiliation. Figure 1 shows the voters' payoffs depending on the winning candidate's quality and

	Elected Candidate's Quality	
Elected Candidate's Party	High Quality	Low Quality
Own Party	x_H	x_L
Other Party	$x_H - \epsilon$	$x_L - \epsilon$

Table 1: Voters' Payoffs

party affiliation where $x_H - x_L > \epsilon > 0$.[4]
Yet, voters do not know the realization of the quality of the candidates but the distribution of types: Each candidate is of high and low quality, respectively, with probability 0.5 and candidates' types are perfectly negatively correlated. Voting is voluntary and there is no cost of voting. We consider a fist-past-the-post voting system where ties are broken randomly. Our results depend on the fact that a voter's vote choice only has an influence on the election outcome in case he is pivotal. A voter can be pivotal if either one candidate leads by exactly one vote or if the election is tied.

2.1 Truthful Campaigns

Candidates engage in campaign advertising to signal that they are of high quality. Advertising is truthful ("truthful campaign") meaning that candidates cannot lie about their quality. Hence, only high quality candidates can send advertisements. We assume that candidates always advertise but voters not necessarily receive the advertisement: Each voter receives an advertisement with probability p. If a voter receives an advertisement, it truthfully reveals which candidate is of high quality and thus it also reveals that the other candidate is of low quality (as types are perfectly negatively correlated). Figure 1 shows the timing of the game: First, candidates send advertisements, then voters - having either received an ad or not - make their vote choice, and afterwards the winner is announced and payoffs realize.

[4]This assumption ensures that voters prefer a high quality candidate from the other party to the low quality candidate of the own party.

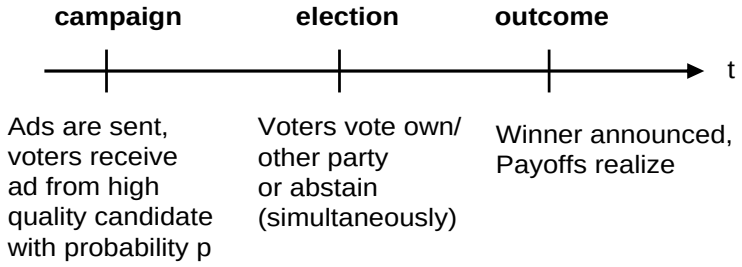

Figure 1: Timing

We consider symmetric pure strategy Bayesian equilibria of the voting game. Voters form beliefs about the distribution over states conditional on the event that their vote is pivotal and their private information.

2.1.1 Informed Voters' Behavior

First we consider the behavior of voters who received an advertisement. If a voter receives an advertisement, she perfectly knows which candidate is the high quality one and which the low quality one. Given the assumed structure of voter preferences, informed voters have a dominant strategy to vote for the high quality candidate (compare Figure 1).

2.1.2 Uninformed Voters' Behavior

Now we turn to the behavior of voters who did not receive an advertisement. If a voter does not receive an advertisement, he cannot update his beliefs and thus believes it is equally likely that (i) the Triangle candidate is of high

quality while the Circle candidate is of low quality or (ii) the Triangle candidate is of low quality and the Circle candidate of high quality. There are two possible symmetric pure strategy equilibria. We derive these equilibria in the Appendix. In the first equilibrium, all uninformed voters abstain ("Abstention equilibrium"). The intuition is that an uninformed vote may cancel out an informed vote: An uninformed voter's expected utility is highest in case she abstains – given that all informed voters vote for the high quality candidate and all other uninformed voters abstain – if the probability that there is an informed vote is sufficiently high.
In the second equilibrium, uninformed voters vote the own party's candidate ("All vote equilibrium"). Here the intuition is that when all other uninformed voters vote, it can be more likely that her vote cancels out another uninformed vote for the other party's candidate than an informed vote. Thus, she better votes for her own party's candidate than abstains. This equilibrium arises when the probability of being informed is sufficiently low. As the threshold for the probability of receiving an advertisement is lower for the first equilibrium than for the second one, there exists a range in which both equilibria exist. Figure 2 illustrates the ranges for both equilibria.

2.2 Deceptive Campaigns

In deceptive campaigns, advertising need no longer be truthful. Both types of candidates engage in campaign advertising claiming that they are of high quality. Hence, advertisements from high quality candidates are truthful but advertisements from low quality candidates are false. As for truthful campaigns, we assume that candidates always advertise but voters not necessarily receives the advertisement: As before, each voter receives an advertisement from the high quality candidate with probability p but with probability $q < p$ she receives an advertisement from the low quality candidate. This implies that each voter can either receive none, one or two advertisements. It is important to note that voters who received two ads and voters who received zero ads both believe that the two states of the world are equally likely. This implies that in equilibrium both groups use the same strategy (cf. the

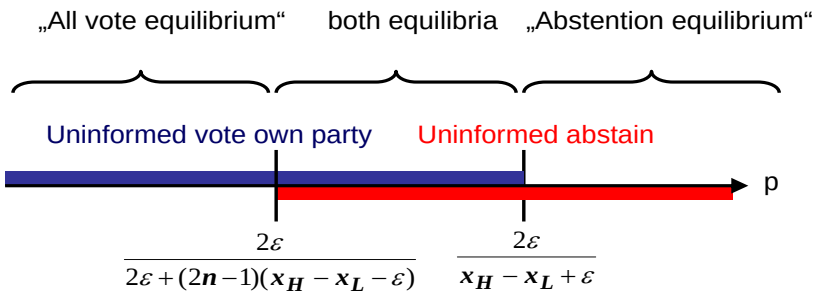

Figure 2: Equilibria in Truthful Campaigns

Appendix).

We demonstrate in the appendix that the "All vote equilibrium" which exists for truthful campaigns no longer exists in deceptive campaigns – at least for the parameters that we use in the experiment (cf. Section 3). The "Abstention equilibrium", however, still exists, i.e. voters who receive exactly one advertisement vote for the candidate they received the advertisement from and voters who received either two advertisements or none abstain. We derive this equilibrium in the Appendix. Since an advertisement need no longer truthfully reveal a candidate's type, an advertisement is less informative. Thus, there are no longer "perfectly informed" votes. This implies that the motive to cancel out another uninformed vote for the other party's candidate to give more weight to the informed votes – as we had for truthful campaigns – becomes less important. Moreover, the probability of receiving an ad is higher now than in truthful campaigns and thus there are more "informed" votes. Other plausible equilibria in which all voters vote are not

exist either (cf. the Appendix).

3 Experimental Design

All subjects were recruited from George Mason University's student population via an automated recruitment mechanism. The experiment was implemented entirely on computers using software created specifically for election experiments with campaign advertising. Subjects were seated in the laboratory at individual computer terminals. They could not see other subjects' decisions. Once seated, subjects completed the computerized instructions which included an interactive quiz. A transcript of the instructions is given in the Appendix. After all subjects successfully completed the instructions, they were acquainted with the software interface and the "mouse-over" technology. First, subjects were told that mouse-clicking is not necessary during the experiment but all decisions can be executed by moving the cursor oven the appropriate area on the screen ("mouse-over"). Due to this technology, subjects cannot hear whether other subjects receive an advertisement. Then, subjects practice two interactive campaigns. In the practice rounds no money is earned. After the practice rounds, paid rounds began. 44 Subjects participated in 39-40 two-candidate campaigns and elections. Overall, we have 1738 voting decisions.

The experiment included multiple rounds. In each round, half of the subjects, the voters, were randomly assigned to each party (the experiment is run with an even number of subjects). Political parties were represented by *Triangle* or *Circle*. A party's candidate[5] was assigned a pattern, *Striped* or *Solid*, which represents a candidate's quality or ideological position. In each round, one party's candidate was randomly assigned as *Striped* and the other one as *Solid*. Voters know the party of each candidate (*Triangle* or *Circle*) but not their quality (*Striped* or *Solid*). We set voters' incentives such that all voters are swing voters: they prefer *Striped* to *Solid* candidates but within

[5]Candidates are no subjects but labels.

	Elected Candidate's Quality	
Elected Candidate's Party	Striped	Solid
Own Party	7.50	4.50
Other Party	7.00	4.00

Table 2: Voters' Payoff

a quality, they prefer a candidate of their own party.[6] Hence, a voter's payoff depended on her own party assignment and the party and the quality of the winning candidate.

Table 2 shows the payoff of a voter. Payoffs are expressed in experimental points, which are converted at a known exchange rate (12 to 1) to US dollars at the end of the experiment.

A round proceeded as follows. At the beginning of each round, subjects have been informed about their party affiliation. Then, in a one-minute campaign period, the candidates sent ads to the voters. Each voter received an ad with some probability as we describe below. After the campaign period, all subjects casted a vote for exactly one of the candidates or abstained. The candidate receiving the majority of votes (ties were broken by a computerized random draw) was declared the winner and the outcome was announced to voters. Subjects were also told the cumulative amount that he/she has earned over the course of the experiment. Then a new round began.

We conducted two types of campaigns: Truthful campaigns ("Treatment T") and deceptive campaigns ("Treatment D"). During truthful campaigns, *Striped* candidates send advertisements to voters that provide truthful information to the recipient that the candidate's quality is *Striped*. During deceptive campaigns, striped and solid candidates send advertisements to voters which only provide truthful information to the recipient about the candidate's quality when the advertisement is sent by a striped candidate.

[6]One interpretation of the candidates' pattern is that all voters preferring a moderate (*Striped*) candidate of either party to a extreme (*Solid*) one. Alternatively, we can think of any other valence criterion that all voters favor.

When the advertisement is sent by a *Solid* candidate, the advertisement falsely claims that the candidate is *Striped*.

In total, we conducted 40 campaigns. We used a within subjects design; i.e. campaign advertising treatments varied by round according to a predetermined (random) pattern.[7] 20 campaigns were truthful and 20 campaigns were deceptive. Subjects are not told how many campaigns are run in the experiment, nor the distribution of treatments. Before a campaign started it was announced whether the campaign will be truthful or deceptive, i.e. there was an announcement whether only Striped or also Solid candidates send ads. In contrast to a between subject design, the within subject design allows us to control for unobservable subject differences.

In truthful campaigns, the probability of receiving an ad from the *Striped* candidate was 0.2 for each voter. In deceptive campaigns, the probability of receiving an ad from the *Striped* candidate was again 0.2 for each voter and for receiving an ad from the *Solid* candidate was 0.05 for each voter. Consequently, during any truthful campaign, some subjects might see one advertisement (from the *Striped* candidate) while others see none. During any deceptive campaign, some subjects might see two advertisements (one from the *Striped* candidate, one from the *Solid* candidate), some might see one advertisement (from the *Striped* or from the *Solid* candidate), and some subjects might see none.

By comparing the two campaign advertising treatments we can analyze the effect of deceptive advertising on voter behavior, in particular on voter turnout, and on the efficiency of the election.

4 Theoretical Predictions

In this section, we summarize the equilibrium predictions of our model for voter behavior and efficiency of the electoral outcome.

[7] This predetermined pattern also included the random choice of candidates' types. It was designed such that each candidate was the high type in half of all 40 campaigns.

4.1 Voter Behavior

Given our theoretical analysis, we hypothesize that in Treatment T voters who received an advertisement vote for the candidate who sent the advertisement. Those voters who did not receive an ad either vote for the own candidate or abstain since our parameters are chosen such that we are in the range where both equilibria exist.
For Treatment D, we hypothesize that voters who received exactly one advertisement vote for the candidate who sent the advertisement while voters who receive two or zero ads rather abstain. This might imply that more voters abstain in Treatment D.

4.2 Efficiency of the Electoral Outcome

Suppose the state of the world is common knowledge among voters. In this case, the election outcome will be that the Striped candidate wins the election. Taking this case as a benchmark, we say the electoral outcome is efficient when the Striped candidate wins the election and it is inefficient when the Solid candidate wins. To compare efficiency of the electoral outcome in truthful and deceptive campaigns to this benchmark, we assign an efficiency value of 1 to elections in which the Striped candidate wins and a value of 0 when the Solid candidate wins. When there is a tie, it is randomly decided which candidate wins, thus we assign an efficiency value of 0.5 in case of a tie.
Consider first truthful campaigns. According to our theoretical prediction, informed voters always vote for the Striped candidate. Hence, if uninformed voters abstain and at least one voter is informed, the Striped candidate wins and thus the outcome is efficient. The probability that at least one voter is informed is $1-(1-p)^N$. For our parameter values, this probability becomes 0.993. Thus, the probability that the Striped candidate wins the election is higher than 99%. Suppose now, uninformed voters do not abstain but vote their own candidate. This implies that in each state of the world at least half of all voters vote for the high quality candidate. To see this, suppose the Circle candidate is of high quality. Thus, only the Circle candidate can

send ads. All voters leaning towards the Circle party vote for the Circle candidate – irrespective of whether they receive an ad or not. Voters leaning towards the Triangle party vote the Triangle candidate unless they receive an ad from the Circle (high quality) candidate. Since half of the voters lean towards the Circle and Triangle party, at least half of them vote for the high quality candidate. Hence, either the high quality candidate wins for sure or there is a tie. A tie arises if exactly none of the Triangle voters receives an advertisement – which happens with probability $(1-p)^{11}$. The same holds true in case the Triangle candidate is of high quality. Expected efficiency is thus $0.5 * (1-p)^{11} = 0.957$. Taken together, independent of whether uninformed voters abstain or vote the own candidate, expected efficiency is at least 0.95 in truthful campaigns.

In deceptive campaigns, expected efficiency is slightly lower: According to our equilibrium prediction, the Striped candidate wins with probability 91% and there is a tie with probability 3.3%.[8] Thus, expected efficiency for Treatment D is about 0.927, which is only slightly lower than in Treatment T.

5 Results

The experiment lasted about one hour. Subjects were paid privately at the end of the experiment and earned $ 20 on average. In the following, we first discuss voter behavior and then election outcomes.

5.1 Voter Behavior

To analyze the effect of deceptive advertising on voting behavior, we distinguish between voters who received an advertisement ("informed voters") and those who received none ("uninformed voters").[9] First, we consider uninformed voters' behavior. In both treatments, uninformed voters tend to

[8] We ran a Monte Carlo simulation with about one million draws to get these probabilities.

[9] In Treatment D, we drop the few voters who received two advertisements since it is difficult to classify them: they received ads but are in fact uninformed as their posterior belief equals their prior belief. Results do not change if we include these few observations (two advertisements are received in 1.17% of the observations in Treatment D).

vote the own party (60% and 64%, resp.) and a significant fraction of them abstains (about 25%). Figure 3 shows for both treatments the percentages of uninformed voters who abstain, vote the own party or vote the other party. In deceptive campaigns, voters are less likely to vote their own party's candidate and instead vote for the candidate from the other party.[10]

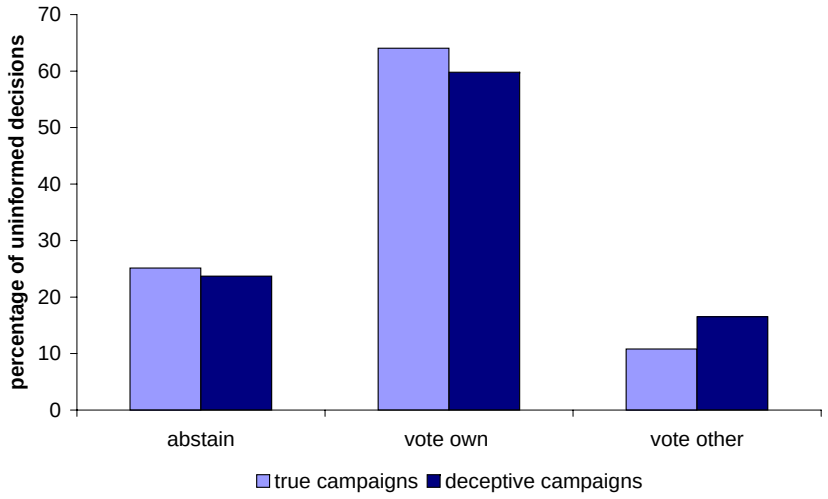

Figure 3: Voting decision of uninformed voters in Treatment T vs D

When advertisements are truthful (Treatment T), receiving an advertisement has a huge effect on the voting decision: Almost no informed voter abstains and roughly the same amount of voters vote the own and the other party's candidate (compare Figure 4). The latter observation already indicates that truthful information seems to be quite effective (as theory predicts). Since we randomized the own party affiliation as well as which candidate is the high quality candidate over campaigns, on average, informed voters should vote for the own and the other candidate in half of the campaigns if they

[10]This effect is significant according to a multinomial logistic regression (compare Table 3).

vote for the high quality candidate. Informed voters' behavior shows exactly this pattern in Treatment T. We analyze this issue in more detail in Section 5.2.

In Treatment D, however, when advertisements can be false, the mere fact of receiving an ad does not change behavior that much (compare Figure 5): Compared to uninformed voters, only slightly less informed voters abstain, and slightly more informed voters vote for the other party's candidate if they receive an advertisement. Relatively to Treatment T, however, the effect is small. In particular, turnout of informed voters in Treatment D is strikingly low compared to Treatment T. The reason behind this observation is that in contrast to Treatment T, informed voters in Treatment D rather abstain than vote for the other party's candidate. Informed voters' behavior in Treatment D does not follow the pattern observed in Treatment T (compare Figures 4 and 5).

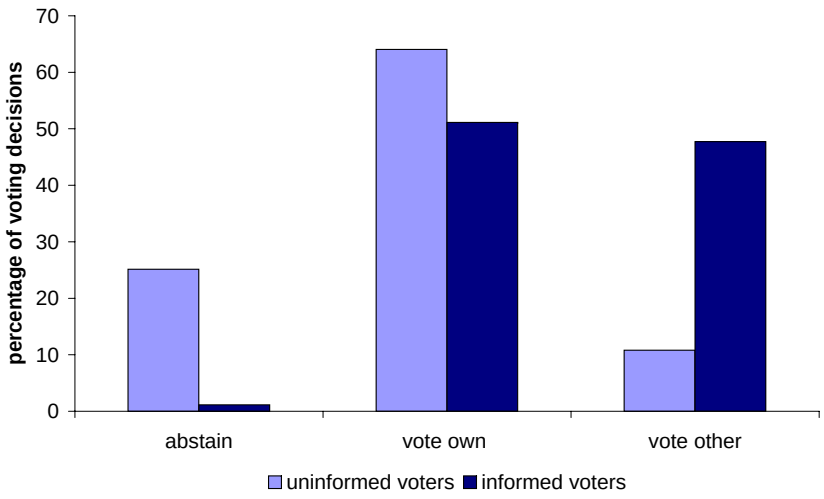

Figure 4: Voting decision of informed vs uninformed voters in Treatment T

Informed voters in Treatment D are reluctant to vote for the other party's

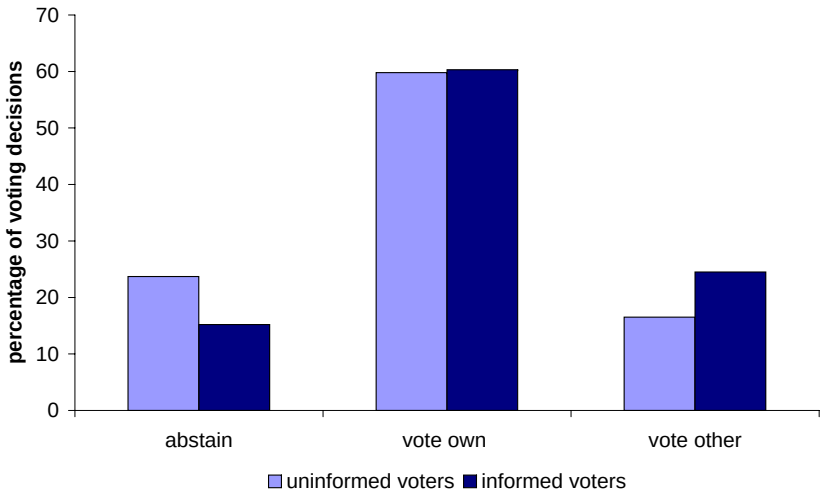

Figure 5: Voting decision of informed vs uninformed voters in Treatment D

candidate. They rather stick to their own candidate or abstain. The difference in informed voter's behavior across treatments can be seen even more clearly in Figure 6: In Treatment T almost all voters switch to the other party's candidate if they receive his advertisement. In Treatment D, however, many voters do not switch when they receive the other candidate's advertisement but abstain or stick to the own candidate.

In order to consider the combined effects across treatments, we estimate a multinomial logistic regression with the vote choice (i.e. vote the own candidate, the other candidate or abstain) as the dependent variable. As independent variables we include the campaign number (Campaign), a treatment dummy (Treatment D), dummies for receiving an ad from the own or other party's candidate (Ad from own/other candidate), and an interaction of the treatment and whether the voter received (at least) one advertisement (Treatment D * Seen ad). The results of the estimation are presented in Table 3. Overall, we find that information tends to reduce abstention. When voters

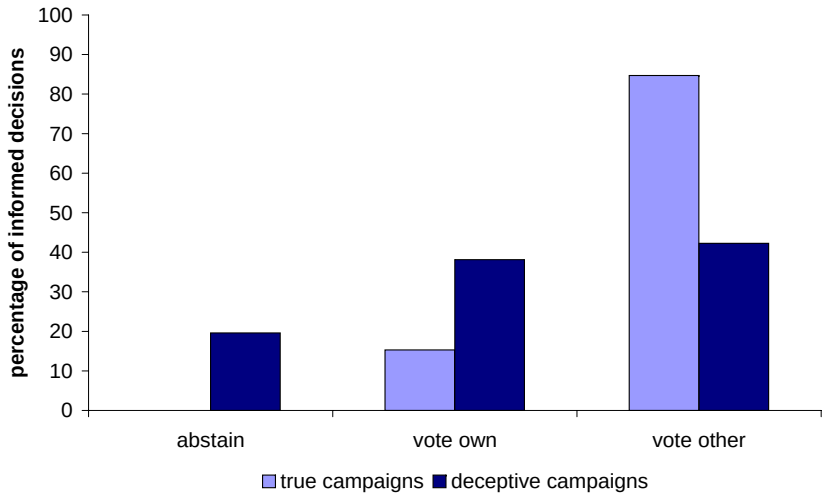

Figure 6: Voting decision given ad from other candidate in Treatment T vs D

receive an advertisement from the own candidate, they are less likely to abstain and less likely to vote for the other candidate. When voters receive an advertisement from the other candidate, they are more likely to vote this candidate. As already noted above, uninformed voters are less likely to vote their own candidate in deceptive campaigns and instead vote the other candidate. Moreover, informed voters are more likely to abstain in deceptive campaigns and less likely to vote for the other candidate.
In the following section we analyze whether deceptive advertising has an effect on the efficiency of the electoral outcome.

5.2 Efficiency of the Electoral Outcome

First, we ask whether truthful information is as effective as theory predicts. This is indeed the case: Informed voters tend to vote for the high quality candidate (compare Figure 7). In Treatment D, however, information fails

	Multinomial Logistic Estimation	
Vote Choice*	Coefficient	$Pr > \|z\|$
Abstain		
Campaign	−0.000	0.999
Treatment D	0.024	0.907
Ad from own candidate	−3.004	0.000
Ad from other candidate	−1.680	0.017
Treatment D * Seen ad	2.007	0.004
Constant	−0.9373	0.107
Vote other		
Campaign	0.008	0.266
Treatment D	0.488	0.008
Ad from own candidate	−0.761	0.021
Ad from other candidate	3.130	0.000
Treatment D * Seen ad	−1.527	0.000
Constant	−2.103	0.000
No. Observations	1738	
Pseudo R^2	0.1033	

*Base outcome: vote own candidate.

Table 3: Multinomial Logistic Estimation of Vote Choices (clustered by subject)

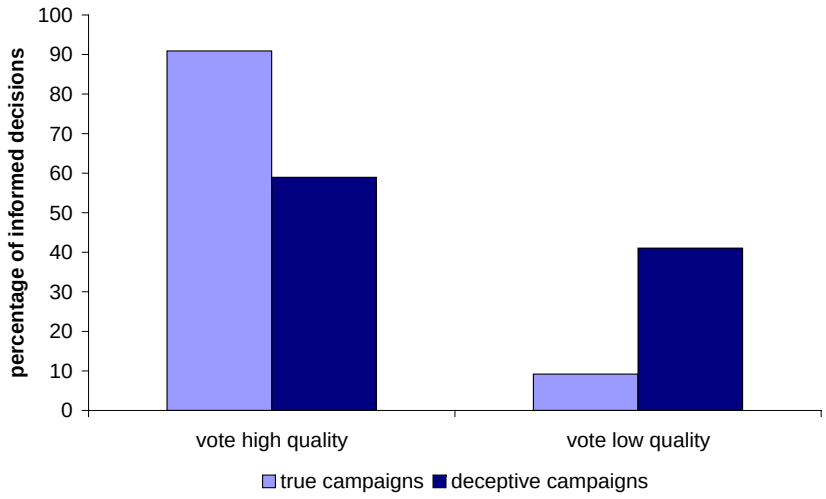

Figure 7: Fractions of informed voters voting for the high and low quality candidate

to be effective. Informed voters in Treatment D rather abstain than vote for the high quality candidate as we have seen in the preceding section. Their behavior strongly departs from voting for the own and other candidate with equal probabilities. Figure 7 clearly shows this: While voters vote for the high quality candidate when advertising is truthful, they fail to do so when advertising is deceptive.

These observations already suggest that deceptive advertising affects the efficiency of the electoral outcome. As derived earlier, predicted efficiency of the electoral outcome for Treatment T is about 0.95 to 0.99. For Treatment D, predicted efficiency is slightly lower (about 0.93).

To compare the observed efficiency of the electoral outcome across treatments, we analyze how often the Striped or Solid candidate wins the election and how often candidates tie. We assign an efficiency value of 1 if the Striped candidate wins, 0.5 is there is a tie, and 0 if the Solid candidate wins. Given

these values, average efficiency in Treatment T is 0.89 and in Treatment D it is only 0.49. While average observed efficiency in Treatment T is almost as high as predicted, it is much lower than predicted in Treatment D. Deceptive advertising is much more likely to lead to the election of the low quality candidate: Efficiency in Treatment D is significantly lower than in Treatment T (t-test, $p = 0.00$, two-tailed).[11] Figure 8 illustrates this result.

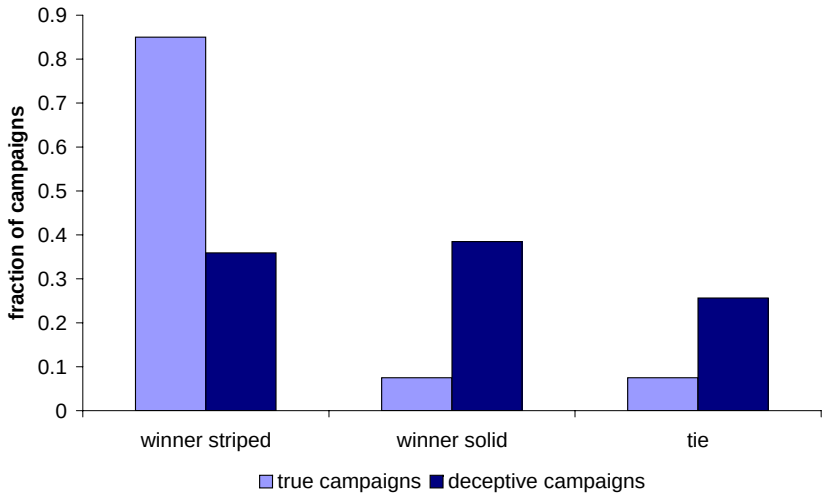

Figure 8: Efficiency of the electoral outcome

6 Conclusion

It is well-known that candidates do not always tell the truth during electoral campaigns. Hence, the question arises how lying affects voter behavior, turnout, and the efficiency of the electoral outcome. In this paper, we address this question using laboratory experiments in which campaign advertising is

[11] If we exclude ties, results do not change (t-test, $p = 0.00$, two-tailed).

exogenous and is either truthful or may be deceptive. In line with previous studies, we find that informative advertising increases voter turnout. Yet, we find that voters who received an advertisement and who know that advertising may be deceptive are less likely to participate than if advertising is truthful. Moreover, voters are reluctant to vote for the other party's candidate if they received an advertisement from him if they know that advertising may be deceptive. Voters who did not receive an advertisement are less likely to vote for the own party's candidate but instead vote for the other party's candidate when deception becomes possible. These changes in behavior strongly affect the election outcome: Efficiency of the election is extremely reduced in deceptive campaigns.

What are the implications for naturally occurring elections and turnout? Our results provide some evidence that already a very small probability of false advertising changes voter behavior. Although informative advertising increases participation, it induces informed voters to less likely participate when knowing that the advertising may be deceptive. Moreover, our results suggest that even a small probability of deception drastically reduces the efficiency of the election outcome.

Appendix - Instructions

Welcome to today's experiment! You will be taking part in a decision making study. We are interested in your decisions that you make on your own. That means, now that the experiment has started, no talking, please. Please turn off all electronic devices. If you have any questions at any time during the experiment, or have any trouble with the computer, please raise your hand, and we will come to you to answer your question.
As you proceed through these instructions, there will be a quiz question at the bottom of certain pages. You must answer the question correctly before going to the next page.
When you are finished reading a screen, click the <Next> button to continue.

Overview

You are a voter in a series of election campaigns. At the beginning of each campaign you are randomly assigned to a party: either the Circle party or the Triangle party. At the end of each campaign you vote for either the Circle party candidate or the Triangle party candidate. The amount of money you earn in each campaign depends on whether the elected candidate is Striped or Solid. You earn more money if the elected candidate is Striped, regardless of the candidates party affiliation.
Whether a partys candidate is Striped is random and can be different in each campaign. Candidates send advertisements saying that they are Striped.
These advertisements are true if they are made by a Striped candidate. The advertisement is false if it is made by a Solid candidate.
In each campaign you will make a voting decision.

We next describe the specifics of the experiment.

Parties

You will be a voter assigned randomly to a political party. The two parties

are the Circle Party and the Triangle Party. Each party will be represented by one candidate. There are an even number of voters, so in each campaign half the voters will be Circle party and half will be Triangle party.
You will be randomly reassigned to a party at the beginning of each of the campaigns. Party assignment will not affect your ability to earn payoffs during the experiment.

Question: If you are a Circle voter in campaign 1, how many times is it possible for you to be assigned to the Circle party in subsequent campaigns?
A: None B: No limit C: 1 D: 2

Combinations of Striped and Solid Candidates

Whether a candidate is Striped or Solid is randomly determined at the beginning of each campaign. The two possible Striped and Solid candidate combinations are listed below. Both combinations are equally likely in any campaign.

(1) Circle candidate is Striped
Triangle candidate is Solid

(2) Circle candidate is Solid
Triangle candidate is Striped

Candidate Advertisements

In some campaigns only Striped candidates advertise.
In others Striped and Solid candidates advertise.
If candidates can send ads, they always advertise.
You might not see a candidate's advertisement.
Striped candidates will advertise that they are striped. Solid candidate will also send advertisements, falsely claiming they are striped.

In each campaign, your chance of seeing a Striped candidate's ad is 1 in 5. In campaigns in which Solid candidates can send ads (which claims that he or she is striped) your chance of seeing a Solid candidate's ad is 1 in 20.

When you receive an ad, you will see a pop-up window alerting you that you have received an ad. Also, in the bottom panel of your screen, the shading of the candidate's symbol will change to Striped.
When Solid candidates advertise, a question mark will appear in the candidate's symbol as the candidate can actually be Solid or Striped.

Voting

To make your voting decision, you will use the voting screen.
In each campaign you have the option to either vote or not to vote (that is, to abstain).
When you move your mouse over one of the buttons, a message box will appear asking you to confirm your choice. You will not be able to change your decision once it has been confirmed. Ties will be broken randomly.
After everyone has voted, the election results will be shown to all participants. You will see the results along with your personal earnings for the campaign.

Abstentions

"Abstain" means simply that you wish to cast a vote for neither candidate. Choosing to vote or to abstain may affect the outcome of the election.
Your earnings depend on which candidate wins the election, and your earnings will be the same whether you voted for Circle, Triangle, or you chose to Abstain.

How You Earn Money

Your earnings are determined by the election outcome. Potential earnings listed below are in experimental dollars, E$, which will be converted to US

dollars at a rate of E$10 = $1. The election outcome affects your earnings in one of four ways:

* The candidate in your party wins and that candidate is Striped: You earn E$7.50.
* The other party's candidate wins and that candidate is Striped: You earn E$7.00.
* Your party's candidate wins and that candidate is Solid: You earn E$4.50.
* The other party's candidate wins and that candidate is Solid: You earn E$4.00.

Your earnings are always higher when the Striped candidate wins.

Example Question

Question: You are a Circle voter. A Striped Triangle candidate won the election. How much did you earn this round?
A: E$7.50 B: E$7.00 C: E$4.00 D: E$4.50

There will be multiple campaigns in this experiment. Your party affiliation will be randomly reassigned in each campaign.
Before each campaign begins, a screen will tell you your party affiliation for that campaign. It will also tell you whether only Striped or also Solid candidates send ads.
At the conclusion of the final campaign, a summary screen will display your total earnings including your show-up bonus.
Please sit quietly after the experiment has concluded and wait to be called to receive your earnings.
Click the <Finished> button to begin the experiment.

Appendix - Equilibria in Voting Game

We consider a game with a set of N voters and two Candidates A and B. There are two states of the world: HL (candidate A is high type and B is low type) and LH (candidate B is the high type and A the low type). Both states are equally likely. Half of the voters ($n := N/2$) are labeled A-types, the other half B-types. A-types (B-types) have a slight preference for the A (B) candidate. $Pr(P_0|HL)$ denotes the probability of a tie given state HL, $Pr(P_A|HL)$ the probability that A lags by one vote given HL, $Pr(P_B|HL)$ means B lags by one vote given state HL, and similarly for state LH. x_{AH} denotes the payoff for an A-type if A wins and is the high type (i.e. own candidate is the high type and wins), other payoffs are denoted accordingly.

In the following, to derive equilibrium strategies, we determine the best response of an A-type voter for given strategies of the other $n-1$ A-types and the n B-types.
To do so, we need the expected payoffs for an uninformed A-type (who did not receive an ad and thus believes both states of the world are equally likely) if the A-type abstains (0), votes for own candidate (A) or votes for other candidate (B) are as follows (where we drop the payoff for the case that a voter is not pivotal as then his vote choice does not matter):

$$\begin{aligned} u_A(0) = &\frac{1}{2}[Pr(P_0|HL)\frac{1}{2}(x_{AH}+x_{BL}) + Pr(P_A|HL)x_{BL} + Pr(P_B|HL)x_{AH}] \\ &+\frac{1}{2}[Pr(P_0|LH)\frac{1}{2}(x_{AL}+x_{BH}) + Pr(P_A|LH)x_{BH} + Pr(P_B|LH)x_{AL}] \end{aligned}$$

$$\begin{aligned} u_A(A) = &\frac{1}{2}[Pr(P_0|HL)x_{AH} + Pr(P_A|HL)\frac{1}{2}(x_{AH}+x_{BL}) + Pr(P_B|HL)x_{AH}] \\ &+\frac{1}{2}[Pr(P_0|LH)x_{AL} + Pr(P_A|LH)\frac{1}{2}(x_{AL}+x_{BH}) + Pr(P_B|LH)x_{AL}] \end{aligned}$$

$$u_A(B) = \frac{1}{2}[Pr(P_0|HL)x_{BL} + Pr(P_A|HL)x_{BL} + Pr(P_B|HL)\frac{1}{2}(x_{AH} + x_{BL})]$$
$$+\frac{1}{2}[Pr(P_0|LH)x_{BH} + Pr(P_A|LH)x_{BH} + Pr(P_B|LH)\frac{1}{2}(x_{BH} + x_{AL})]$$

First, we derive equilibrium behavior for truthful campaigns, then for deceptive campaigns.

Truthful Campaigns

In truthful campaigns, voters receive an ad from the high quality candidate with probability p. Thus, voters can only get an ad from exactly one candidate in each state of the world. They can never get two ads.
As argued in the text, informed voters have the dominant strategy to vote for the candidate they received the ad from. In the following analysis, we therefore assume that informed voters follow this strategy.
Now we turn to uninformed voters behavior. First, we check whether it can be that uninformed voters abstain in equilibrium. Under the assumption that uninformed voters abstain and ads are truthful, the probability of a tie when there are $n-1$ A-types and n B-types is exactly the probability that no one gets an ad. Otherwise all informed voters would vote for the high quality candidate so that a tie is impossible as uninformed voters abstain. This holds true for state HL as well as for state LH. The probability that A lags by one vote in state HL must be zero since only the high type (A) can send ads. Thus, there will either be a tie or A will lead. Similarly, the probability that B lags in state LH must be zero. The probability that A leads by exactly one vote in state HL (and similarly the probability that B leads by one vote in state LH) equals the probability that exactly one voter receives an ad and thus votes for the high quality candidate.
Using these results, expected payoffs for an uninformed A-type become:

$$u_A(0) = \frac{1}{2}[P_0\frac{1}{2}(x_{AH} + x_{BL}) + P_1x_{AH} + P_0\frac{1}{2}(x_{AL} + x_{BH}) + P_1x_{BH}]$$

$$u_A(A) = \frac{1}{2}[P_0 x_{AH} + P_1 x_{AH} + P_0 x_{AL} + P_1 \frac{1}{2}(x_{AL} + x_{BH})]$$

$$u_A(B) = \frac{1}{2}[P_0 x_{BL} + P_1 \frac{1}{2}(x_{AH} + x_{BL}) + P_0 x_{BH} + P_1 x_{BH}]$$

where $P_0 := Pr(P_0|HL) = Pr(P_0|LH) = (1-p)^{2n-1}$ and
$P_1 := Pr(P_B|HL) = Pr(P_A|LH) = (2n-1)p(1-p)^{2n-2}$.
Is it a best response for an uninformed voter to abstain?

$$u_A(0) - u_A(A) = \frac{1}{4}(1-p)^{2n-2}[(1-p)(x_{BH} - x_{AH} + x_{BL} - x_{AL}) + (2n-1)p(x_{BH} - x_{AL})]$$

For our payoff parameters this becomes

$$u_A(0) - u_A(A) = \frac{1}{4}(1-p)^{2n-2}[(1-p)(-2\epsilon) + (2n-1)p \cdot (x_H - x_L - \epsilon)].$$

This difference is larger than zero if $p \geq \frac{2\epsilon}{2\epsilon + (x_H - x_L - \epsilon)(2n-1)}$. Thus, the uninformed voter rather abstains than votes the own candidate if p is sufficiently large. [12]
She also does not want to vote the other candidate but rather abstains:

$$u_A(0) - u_A(B) = \frac{1}{4}[(P_0 + P_1)(x_{AH} - x_{BL}) + P_0(x_{AL} - x_{BH}] > 0.$$

As argued earlier, informed voters perfectly know the state of the world and thus it is a best response to vote for the high quality candidate for our payoff parameters.
Hence, there exists an equilibrium, in which the uninformed voters abstain and the informed ones vote for the high quality candidate iff $p \geq \frac{2\epsilon}{2\epsilon + (x_H - x_L - \epsilon)(2n-1)}$.

Next, we ask whether it can be a best response for the uninformed to vote for the own candidate.

[12] Note that the threshold is smaller than 1.

This implies that no one abstains. Hence, when all $2n-1$ voters vote – all but our A-type voter – the probability of a tie is zero: $2n-1$ is an uneven number and no one abstains. The probability that A lags by one vote in state HL need no longer be zero since uninformed voters vote for the own candidate. This probability equals the probability that either no voter receives an ad or only A-types receive ads, i.e. the probability that no B-type receives an ad. Then B gets exactly one vote more than A as there are n B-types. As soon as one B-type would receive an ad – independent of whether the A-types are informed or not – A would get more ads than B (the minimum number of votes for A is $n-1$. Thus, $Pr(P_A|HL) = (1-p)^n$.
The probability that B lags by one in state LH, however, is still zero, i.e. $Pr(P_B|LH) = 0$, as only B can send ads: B receives a minimum of n votes from the B-types whether these are informed or not, and if an A-type receives an ad, she also votes for B.
The probability that B lags by one vote in state HL equals the probability that exactly one B-type receives an ad. There are at least $n-1$ votes for A. If exactly one B-type becomes informed and thus votes for A instead of B, B lags by one vote as A gets n votes and B $n-1$. Thus,
$Pr(P_B|HL) = np(1-p)^{n-1}$.
The probability that A lags by one vote in state LH equals the probability that no A-type receives an ad. Since B now receives at least n votes from the B-types, only if no A-type switches, B leads by exactly one vote, i.e. $Pr(P_A|LH) = (1-p)^{n-1}$.
Using these results, we have

$$u_A(0) - u_A(A) = \frac{1}{4}(1-p)^{n-1}[(x_{BL} - x_{AH})(1-p) + (x_{BH} - x_{AL})]$$

Plugging in our payoff parameters, we get

$$u_A(0) - u_A(A) = \frac{1}{4}(1-p)^{n-1}[(x_H - x_L - \epsilon)p - 2\epsilon]$$

Thus, an uninformed A-type votes the own candidate if $p \leq \frac{2\epsilon}{x_H - x_L - \epsilon}$.

Moreover, it is also better for her to vote the own candidate than the other one as

$$u_A(A) - u_A(B) = \frac{1}{4}(1-p)^{n-1}[(1-p+np)(x_{AH} - x_{BL}) + (x_{AL} - x_{BH})] > 0.$$

Hence, there exists an equilibrium in which uninformed voters vote for the own candidate and informed ones vote for the candidate from which they received the ad if $p \leq \frac{2\epsilon}{x_H - x_L - \epsilon}$.

In the following we show that it cannot be an equilibrium strategy that uninformed voters vote for the other candidate, and informed voters vote for the high quality candidate. The Pivot-probabilities for this case are as follows: $Pr(P_A|HL) = 0$ as all B-types vote for A, thus A gets n votes for sure.
In order that A lags by one vote in state LH all B-types except for one (who then votes B) need to get no ad so that they vote for A since all A-types vote for B, i.e. $Pr(P_A|LH) = n(1-p)^{n-1}p$.
$Pr(P_B|HL) = (1-p)^{n-1}$ as all B-types vote for A (as no ad sent from B), and thus only if all A-types vote for B (i.e. all A-types uninformed) B lags by one vote.
Similarly, $Pr(P_B|LH) = (1-p)^n$ as all A-types vote for B (as no ad sent from A), and thus only if all B-types vote for A (i.e. all B-types uninformed), B lags by one vote.
Moreover, as no one abstains, ties are not possible if $2n-1$ voters vote (before our A-type votes). Then, $U_A(0) - U_B(B) = 1/4(1-p)^{n-1}(x_{AH} - x_{BL}) + (1-p)(x_{AL} - x_{BH}) > 0$, i.e. it would be better for the uninformed voter to abstain than to vote for the other candidate.
Thus, the aforementioned strategy cannot be an equilibrium strategy.
Hence, we have found the only two existing symmetric pure strategy equilibria. Note that it cannot be an equilibrium that voters always vote for the own candidate. In case the voter receives an ad from the other candidate, he is better off when he votes for this candidate. Similarly, it cannot be an equilibrium that voters always vote for the other candidate or always abstain.

Deceptive Campaigns

In deceptive campaigns also the low quality candidate sends ads. Hence, voters can receive none, one or two ads now. With probability p a voter receives an ad from the high quality candidate, with probability q from the low quality candidate. We assume that $p > q$. If a voter receives no ad at all, she only knows that each state realizes with 1/2. If she receives an ad from the own candidate, she knows that the ad is true with probability

$$t = \frac{0.5p(1-q)}{0.5(p(1-q)+q(1-p))}.$$

Note that $t \geq 1/2$ iff $p \geq q$.

For an A-type, this means she expects that she is in state HL with probability t and in LH with $1-t$. Similarly, if an A-type only receives an ad from the other candidate, she expects that she is in state HL with probability $1-t$ and in LH with t. If a voter receives an ad from both candidates, she knows that each ad is true with probability 1/2 and thus that both states are equally likely. Note that this implies that voters who receive none and voters who receive two ads are both uninformed. Therefore, their expected payoff is identical and thus they need to have identical equilibrium strategies. Note that expected payoffs for an uninformed A-type if the A-type abstains (0), votes for own candidate (A) or votes for other candidate (B) are as before for truthful campaigns (yet, the Pivot-probabilities change).

We first ask whether it can be an equilibrium that uninformed voters and those who receive two ads abstain, and informed voters who get one ad vote for the candidate they received the ad from. Consider now an A-type when all other $2n-1$ voters follow this strategy.

The payoff differences that we have to consider when the A-type is unin-

formed or when he received two ads are as follows.

$$\begin{aligned} u_A(0) - u_A(A) = \frac{1}{4}[&(x_{BL} - x_{AH})(Pr(P_A|HL) + Pr(P_0|HL)) \\ &+(x_{BH} - x_{AL})(Pr(P_0|LH) + (P_A|LH)] \\ u_A(0) - u_A(B) = \frac{1}{4}[&(x_{AH} - x_{BL})(Pr(P_B|HL) + Pr(P_0|HL)) \\ &+(x_{AL} - x_{BH})(Pr(P_0|LH) + (P_B|LH)] \end{aligned}$$

We get the expected payoffs for the A-type who received ad from A only, by substituting t and $1-t$ for the probabilities of $1/2$ for the states of the world in the expected payoff formulas for an uninformed A-type that we derived for truthful campaigns where we denote the expected payoff on an A-type who received an ad from A by $u_A(.|ad: \ A)$ and similarly by $u_A(.|ad: \ B)$ if she received an ad from B:

$u_A(0|ad: \ A) - u_A(A|ad: \ A)$

$$\begin{aligned} &= \frac{1}{2}[t(x_{BL} - x_{AH})(Pr(P_A|HL) + Pr(P_0|HL)) \\ &+ (1-t)(x_{BH} - x_{AL})(Pr(P_0|LH) + Pr(P_A|LH)] \end{aligned}$$

$u_A(B|ad: \ A) - u_A(A|ad: \ A)$

$$\begin{aligned} &= [t(x_{BL} - x_{AH})(Pr(P_0|HL) + 1/2(Pr(P_A|HL) + Pr(P_B|HL))) \\ &+ (1-t)(x_{BH} - x_{AL})(Pr(P_0|LH) + 1/2(Pr(P_A|LH) + Pr(P_B|LH))] \end{aligned}$$

$u_A(0|ad: \ B) - u_A(B|ad: \ B)$

$$\begin{aligned} &= \frac{1}{2}[(1-t)(x_{AH} - x_{BL})(Pr(P_B|HL) + Pr(P_0|HL)) \\ &+ t(x_{AL} - x_{BH})(Pr(P_0|LH) + (P_B|LH)] \end{aligned}$$

$u_A(A|ad: \ B) - u_A(B|ad: \ B)$

$$\begin{aligned} &= [(1-t)(x_{AH} - x_{BL})(Pr(P_0|HL) + 1/2Pr(P_A|HL) + 1/2Pr(P_B|HL)) \\ &+ t(x_{AL} - x_{BH})(Pr(P_0|LH) + 1/2(P_A|LH) + 1/2(P_B|LH)] \end{aligned}$$

We simulated the Pivot-probabilities [13] for $n = 11$, $p = 0.2$, $q = 0.05$ under the assumption that uninformed voters and those with two ads abstain, and those who get one ad vote for the candidate who sent the ad:
$Pr(P_0|HL) = 0.061929$
$Pr(P_B|HL) = 0.11642$
$Pr(P_A|HL) = 0.025067$
$Pr(P_0|LH) = 0.061746$
$Pr(P_B|LH) = 0.024971$
$Pr(P_A|LH) = 0.11643$

Plugging in the simulated values and t, the signs of the aforementioned payoff differences become:
$u_A(0) - u_A(A) > 0$ and $u_A(0) - u_A(B) > 0$,
$u_A(0|ad: \ A) - u_A(A|ad: \ A) < 0$ and $u_A(B|ad: \ A) - u_A(A|ad: \ A) < 0$,
$u_A(0|ad: \ B) - u_A(B|ad: \ B) < 0$ and $u_A(A|ad: \ B) - u_A(B|ad: \ B) < 0$.

Hence, for our parameters, there exists an equilibrium where uninformed and those who receive two ads abstain and those with one ad vote for the candidate who sent the ad.

Can it be an equilibrium that uninformed and those who receive two ads vote the own candidate while those who receive one ad vote the candidate they received the ad from?

Again, we simulated the Pivot-probabilities for $n = 11$, $p = 0.2$, $q = 0.05$ now under the assumption that uninformed and those with two ads vote own candidate, those who get one ad vote for the candidate who sent the ad:
$Pr(P_0|HL) = 0$
$Pr(P_B|HL) = 0.26122$
$Pr(P_A|HL) = 0.15001$
$Pr(P_0|LH) = 0$
$Pr(P_B|LH) = 0.055691$

[13] We used Monte Carlo simulations with about one million draws.

$Pr(P_A|LH) = 0.18081$

For the simulated values, payoff differences become:
$u_A(0) - u_A(A) < 0$ and $u_A(0) - u_A(B) > 0$,
$u_A(0|ad: \ A) - u_A(A|ad: \ A) < 0$ and $u_A(B|ad: \ A) - u_A(A|ad: \ A) < 0$,
$u_A(0|ad: \ B) - u_A(B|ad: \ B) > 0$ and $u_A(A|ad: \ B) - u_A(B|ad: \ B) < 0$.

Thus, when receiving an ad from the other candidate, the A-type better abstains than to vote for him given the other voters follow the aforementioned strategy. Hence, we do not have the equilibrium where uninformed and those who receive two ads vote for the own and those with one ad vote for this candidate.

Next we ask whether it can be an equilibrium that voters always vote for the own candidate.

Since there are n B-types this means that B wins if A-type abstains or votes for B. If he votes for A there is a tie. If the voter is uninformed or receives 2 ads, his payoffs are

$$\begin{aligned} u_A(0) &= \frac{1}{2}[x_{BH} + x_{BL}] \\ u_A(A) &= \frac{1}{4}[x_{BL} + x_{AH} + x_{BH} + x_{AL}] \\ u_A(B) &= \frac{1}{2}[x_{BH} + x_{BL}] \end{aligned}$$

Thus, voting for A is optimal.

If the voter is informed about A, his payoffs are

$$\begin{aligned} u_A(0) &= tx_{BL} + (1-t)x_{BH} \\ u_A(A) &= \frac{1}{2}[t(x_{BL} + x_{AH}) + (1-t)(x_{BH} + x_{AL})] \\ u_A(B) &= tx_{BL} + (1-t)x_{BH} \end{aligned}$$

Thus, voting for A is optimal since $t > 1/2$ (as $p > q$) and $x_{AH} - x_{BL} > (x_{BH} - x_{AL})$.
If the voter is informed about B, his payoffs are

$$\begin{aligned} u_A(0) &= (1-t)x_{BL} + tx_{BH} \\ u_A(A) = \frac{1}{2}[(1-t)(x_{BL} + x_{AH}) + t(x_{BH} + x_{AL})] \\ u_A(B) &= (1-t)x_{BL} + tx_{BH} \end{aligned}$$

Since $u_A(A) - u_A(0) = u_A(A) - u_A(B) = \frac{1}{2}(x_H - x_L - \epsilon)(1-2t) < 0$ as $t > 1/2$, voting for A is not optimal.

Hence, no equilibrium in which voters always vote for own candidate.

Similarly, it will never be an equilibrium that all voters always vote for the other candidate. The uninformed would rather vote for the own candidate or abstain than vote for the other one as A wins for sure versus there is a tie.

Finally we ask which other "full-voting equilibria" could arise, i.e. equilibria in which no one abstains.

case 1:
vote other one when two or zero ads, vote own if one ad from own, other if ad from other one

case 2:
vote other one when two or zero ads, vote other if one ad from own, own if ad from other one
Cannot be an equilibrium:
$U_A(B|ad:\ A) - U_A(A|ad\ A) = 1/2[t(x_{BL} - x_{AH})(Pr(P_A|HL) + Pr(P_B|HL))$
$+(1-t)(x_{BH} - x_{AL})(Pr(P_A|LH) + Pr(P_B|LH))$
This must be positive if it is an equilibrium. This means
$\frac{Pr(P_A|LH)+Pr(P_B|LH)}{Pr(P_A|HL)+Pr(P_B|HL)} > \frac{t(x_{AH}-x_{BL})}{(1-t)(x_{BH}-x_{AL})}$.
At the same time

$U_A(A|ad:\ B) - U_A(B|ad\ B)$
$= 1/2[(1-t)(x_{AH} - x_{BL})(Pr(P_A|HL) + Pr(P_B|HL))$
$+t(x_{AL} - x_{BH})(Pr(P_A|LH) + Pr(P_B|LH))$
must be positive. This means
$\frac{Pr(P_A|LH)+Pr(P_B|LH)}{Pr(P_A|HL)+Pr(P_B|HL)} < \frac{(1-t)(x_{AH}-x_{BL})}{t(x_{BH}-x_{AL})}$.
Since we have $1-t < t$:
$\frac{(1-t)(x_{AH}-x_{BL})}{t(x_{BH}-x_{AL})} < \frac{t(x_{AH}-x_{BL})}{(1-t)(x_{BH}-x_{AL})}$. Thus, the two conditions cannot hold at the same time.

case 3:

vote own when two or zero ads, vote other if one ad from own, vote other if ad from other one

Cannot be an equilibrium:

If informed of own candidate, vote for own candidate. $Pr(P_A|HL) = Pr(P_A|LH)$ and $Pr(P_B|HL) = Pr(P_B|LH)$ (as symmetric in q and p and from HL to LH only p and q exchanged).

If informed about own candidate:

$U_A(B)-U_A(A) = 1/2(t(x_{BL}-x_{AH})[Pr(P_A|HL)+Pr(P_B|HL)]+(1-t)(x_{BH}-x_{AL})[Pr(P_A|LH) + Pr(P_B|LH)])$
$= 1/2[Pr(P_A|HL) + Pr(P_B|HL)](t(x_{BL} - x_{AH}) + (1-t)(x_{BH} - x_{AL})) < 0$
since $t > 1/2$.

case 4:

vote own when two or zero ads, vote other if one ad from own, vote own if ad from other one

Cannot be an equilibrium by exactly the same argument as for case 2.

case 5:

vote other when two or zero ads, vote own if one ad from other or one ad from own

Cannot be an equilibrium:

If uninformed:

$U_A(A) - U_A(B) = 1/4[(x_{AH} - x_{BL})(Pr(P_A|HL) + Pr(P_B|HL)) + ((x_{AL} -$

$x_{BH})(Pr(P_A|LH) + Pr(P_B|LH))] < 0$ for equilibrium. And if information about other one:
$U_A(A|ad\ :\ \ B) - U_A(B|ad\ \ B) = 1/2[(1-t)(x_{AH} - x_{BL})(Pr(P_A|HL) + Pr(P_B|HL))$
$+t(x_{AL} - x_{BH})(Pr(P_A|LH) + Pr(P_B|LH)) > 0$
for equilibrium. Since $t > 1/2$ these two conditions cannot hold at the same time.

In all other possible symmetric pure strategy equilibrium candidates, some voters abstain.

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