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DO VOTERS LEARN FROM PRESIDENTIAL ELECTION CAMPAIGNS?

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SOCIAL SCIENCE WORKING PAPER 1022

October 1997

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Abstract

Theory: We present a model of voter campaign learning which is based on Bayesian learning models. This model assumes voters are imperfectly informed and that they incorporate new information into their existing perceptions about candidate issue positions in a systematic manner.

Hypothesis: Additional information made available to voters about candidate issue positions during the course of a political campaign will lead voters to have more precise perceptions of the issue positions of the candidates involved.

Data and Methods: We use panel survey data from the 1976 and 1980 presidential elections, combined with content analyses of the media during these same elections. Our primary analysis is conducted using random effects panel models.

Results: We find that during each of these campaigns many voters became better informed about the positions of candidates on many issues and that these changes in voter information are directly related to the information flow during each presidential campaign.

Do Voters Learn from Presidential Election Campaigns?*

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1 Introduction

Political scientists have long been pessimistic about the effects of presidential campaigns on voter decision making. The pioneering work of the "Columbia School" in the companion volumes *The People's Choice* by Lazarsfeld, Berelson and Gaudet (1944) and *Voting* by Berelson, Lazarsfeld and McPhee (1954) set the agenda both methodologically and substantively for what is now called the "minimal effects" hypothesis. Their goal was to measure the changes in preferences which the Columbia researchers expected to occur during the electoral season and then match those changes in preferences with campaign events and information (Natchez 1985). But instead of documenting dramatic changes, the Columbia team found an amazing stability of preferences throughout the 1940 election: "What the political campaign did, so to speak, was not to form new opinions but to raise old opinions over the thresholds of awareness and decision. Political campaigns are important primarily because they *activate* latent predispositions" (Lazarsfeld, Berelson and Gaudet 1944: 74). In terms of voting decisions, they found that the presidential campaign changed few minds, and for most voters, the campaign only reinforced their predispositions to vote for one candidate or the other. Thus they reached what should have been a startling conclusion: "In sum, then, this is what the campaign does: reinforcement (potential) 53%; activation 14%; reconversion 3%; partial conversion 6%; conversion 8%; no effect 16%" (Lazarsfeld, Berelson and Gaudet 1944: 103). This is a remarkable finding, since only 14% of their sample *changed their voting decision* during the course of a presidential election campaign. Thus began the "minimal effects" hypothesis — that campaigns and the mass media have only minor influences on mass preferences (Iyengar and Kinder 1987).

*An earlier version of this paper was presented at the Southern Political Science Association Annual Meeting, November 1996. We thank the John M. Olin Foundation for sponsoring some of this research. We also thank Thomas Patterson for access to his content analysis of the 1976 presidential election, and Stacy Kerkla for her assistance with content analysis of the 1980 presidential election. Last, we thank Jonathan Katz for helpful discussions. Correspondence can be addressed to the authors at California Institute of Technology, 228-77 DHSS, Pasadena CA 91125. By email, the authors can be reached at rma@crunch.caltech.edu and gg@hss.caltech.edu, respectively.

However, more recently there have been many important works supporting the notion that political campaigns and the mass media have significant influences on the mass electorate — both on their preferences and the criteria underlying those preferences. In the 1976 presidential election, Conover and Feldman (1989) observed that misperceptions of the candidate's stands virtually disappeared as the general election campaign progressed. Working with data on presidential primaries, Bartels (1988) and Popkin (1991) have both shown that campaign events and changes in available information about candidates lead to substantial changes in the criteria voters use to judge candidates, and hence, to changes in their relative evaluations of primary candidates. With data from senate elections, Franklin (1991) has shown that the information made available by the candidates competing for office influences voter perceptions. Zaller, looking at a variety of national elections, summarized his results (and the recent literature): "Campaigns bring about attitude change, as we have sought to show, not by producing a sudden conversion experience, but by producing incremental changes in the balance of considerations that underlie people's summary attitudes" (1989: 231).

More importantly, this literature argues that the effects of campaigns and the mass media should not be expressed directly in changes in electoral preferences — in Iyengar and Kinder's terms, in persuasion. Clearly it is difficult to change the minds of voters, and neither political campaigns nor the mass media are well suited for that task. However, perceptions are more malleable, and are thus more likely to change over the course of a campaign. Perhaps even more subject to change are misperceptions, or the degree to which the perceptions of voters are inaccurate. Most of these works, from the Columbia research to the most recent work summarized above, argue that political campaigns and the mass media can and do influence voter perception and misperception, and therefore, indirectly influence preferences as well. So to study the impact of the political campaign and the media on the electorate, a better focus might be on the perceptions and misperceptions of voters.[1]

In this paper we first offer a theoretical model which provides this focus. We present a simple model of voter learning which produces a flexible and testable model of how voter perceptions respond to new information about the candidates during a presidential campaign. Then we test one important set of implications from the model using data from the 1976 and 1980 presidential elections. We show first that there were substantial changes in the information flows during each of these campaigns; as the election neared, more "substantive" information was presented to voters. Second, we show that with more information about the policy positions of the candidates, voters perceived those positions with greater certainty. We then use a random effects panel model to directly link the campaign information flow with voter learning about each candidate in these two presidential elections. In the end, we demonstrate that the certainty of voter knowledge of candidate issue positions responds to the information flow; this provides strong support for voter learning in presidential campaigns. We conclude with a discussion of the utility of this approach for understanding voter decision making in presidential elections.

2 A Model of Voter Learning

2.1 The Basics of the Learning Model

To examine the dynamic relationship between campaign information and voter perception and preference, we develop a simple model of political learning based on Bayesian updating. The voter learning model we discuss here, like the spatial model of voting, is not a completely descriptive model of behavior. Instead, it provides an explicit, consistent, and systematic accounting of the way in which individuals might combine newly encountered information with their past understandings of the political world.[2] However, Bayesian learning models are increasingly appearing in the political science literature, their empirical applications have been successful (Achen 1992; Alvarez 1997; Bartels 1993; Calvert and MacKuen 1985; Franklin 1992; Husted, Kenny and Morton 1993; Zechman 1978).

The intuition behind our Bayesian model of voter learning is compelling. Basically, the model states that the voter has prior perceptions or information (called "priors"), and that these prior beliefs are updated with the acquisition of new information, yielding revised, "posterior" beliefs. The Bayesian approach provides a particular mathematical framework for the formation of new perceptions. To express the Bayesian model formally, first define θ_{kt} to be candidate k's position on a particular issue at time t, γ_{kt} to be the voter's knowledge of the candidate's position, and η_{kt} to represent information received about the candidate k's position.

Next, instead assuming that voters *should be perfectly informed* during a presidential election season, we assume that they *are imperfectly informed* about candidates and their policy stands (Achen 1975; Alvarez 1997; Alvarez and Franklin 1994). It has long been an established truism that voters are poorly informed (e.g., Campbell et al. 1960), with the debate centering over the causes of their imperfect information (Key 1966). Some of the imperfections in the information flow stem from the candidates and the information transmission process, others from the abilities and incentives of voters (Page 1978: 281).

Here, we assume that the perceptions of the candidate on issues are known imperfectly by the voter, and hence, are described as a set of probability distributions. The voter's prior probability distribution, the voter's calculation of the probability that the candidate will have a certain position once in office, conditioned on their knowledge of that position, is defined by:

$$P(\theta_{kt} \mid \gamma_{kt}) \sim N(\mu_1, \sigma_1^2) \tag{1}$$

This states that the voter's calculation of the candidate's position developed from past knowledge of that position is assumed to be normally distributed with a mean μ_1 and a variance σ_1^2. Similarly, the probability distribution that represents the newly encountered information, η_{kt}, conditioned on the candidate's position and the voter's knowledge of that position is defined as:

$$P(\eta_{kt} \mid \gamma_{kt}, \theta_{kt}) \sim N(\mu_2, \sigma_2^2) \tag{2}$$

And last, the voter's posterior distribution also has a similar definition, where the probability that the candidate is actually at the particular position is conditioned on the voter's knowledge of the position and the newly-encountered information about the candidate:[3]

$$P(\theta_{kt} \mid \gamma_{kt}, \eta_{kt}) \sim N(\mu_3, \sigma_3^2) \tag{3}$$

Now that these probability distributions have been defined, Bayes' Theorem states that the posterior distribution is proportional to the product of the prior distribution and the distribution of the newly-encountered information. That is,

$$P(\theta_{kt} \mid \gamma_{kt}, \eta_{kt}) \propto P(\theta_{kt} \mid \gamma_{kt}) * P(\eta_{kt} \mid \gamma_{kt}, \theta_{kt}) \tag{4}$$

This can be expressed in terms of the moments of these distributions as:[4]

$$\mu_3 = \frac{\tau_1 \mu_1 + \tau_2 \mu_2}{\tau_1 + \tau_2} \tag{5}$$

with:

$$\tau_3 = \tau_1 + \tau_2 \tag{6}$$

Note that $\tau_j = (\sigma_j^2)^{-1}$ for j=1,2,3. While the τ_j are termed "precisions" in the literature, they really are just the inverses of the voter's uncertainty regarding each bit of information — their previous understanding of the candidate's position, the new information received, and their new understanding of the candidate's position (Alvarez and Franklin 1994).

So what is the interpretation of the voter learning model? Where the voter perceives the candidate to stand on the issue, in light of some new information, is the weighted average of their past knowledge of the candidate's position and their newly-obtained information. The weights, further, are simply the precisions of each piece of information, which have been defined as being proportional to the variances of the relevant probability distributions. The voter finds out something new about the candidate's position — from speeches, conventions, advertising, advertisement, the media, or whatever source — and this alters their perception of this position in the direction of the new information. But, and of importance for this discussion, *the amount by which voters alter their perceptions depends on the precision of the new information, relative to their past perceptions.*

In order to highlight the intuition behind the Bayesian model as presented in Equation 6, the effects of newly-obtained information upon both the mean and precision of the voter's posterior distribution regarding the position of the candidate on an issue are shown graphically. We performed two sets of simulations with Equation 6, using the following simulation values. The voter's prior knowledge of the candidate's position (μ_1) is 0.5. The voter then receives new information that the candidate's expected position is 1.5. To assess the effects of the precision of these both the prior and new information on the voter's posterior knowledge, we then varied the precision of the new information

about the candidate's position (τ_2), which takes a range of hypothetical values from zero (extreme imprecision) to 20 (extreme precision), and the precision of the voter's prior knowledge of the candidate's position (τ_1), which we varied across three values, low, moderate, and high. These simulations are given in figure 1, where the top panel gives the mean of the voter's posterior knowledge and the bottom panel gives the posterior precision. In each panel, the lines represent one of the assumed levels of prior precision while the x-axis gives the precision of the new information.

Figure 1 Goes Here

What is interesting to notice in the top panel of figure 1 is the effect which the two precisions have on the voter's adjustment of their perception. When the precision of their prior knowledge is low, even relatively imprecise new information can induce a dramatic change in the posterior mean in favor of the new information. However, as the precision of the prior knowledge increases, the voter places more weight on their prior knowledge than on the new information, so the new information must be extremely precise to induce a change in the perception of where the candidate stands on the particular issue.

In the bottom panel of figure 1 the y-axis represents the precision of the posterior distribution. Recall that the posterior precision is simply the sum of the precision of the prior knowledge and the new information, which accounts for the linear relationships seen in the figure. Not surprisingly, a positive relationship is observed in the figure for each level of prior precision, indicating that as the precision of the new information increases, so does the precision of the posterior. Also worth notice here is that new information in the model always increases posterior precision. Thus, the model predicts that if the voter has a very precise prior understanding of where the candidate stands on the issue, and encounters very precise information which leads them to update their prior perceptions, the precision of their posterior knowledge will be greater, though not by a very large amount.[5]

Thus far we have demonstrated two aspects of the Bayesian learning model: the effects which newly-obtained information has on each element of the voter's knowledge of the candidate's policy stands — the mean and precision (or variance) of that distribution. The next step is to show how changes in voter perception of candidate issue positions are incorporated into their evaluations of the candidates. For this purpose, we use the spatial model of voting.[6]

In this version of the spatial model, we assume there are two candidates and that the preferences and utility functions of voters are such that the axioms of expected utility maximation apply. Also, we assume that there is one policy dimension relevant to the voter, and that the voter takes only information about their position and the candidate's position on this issue into account. The voter's expected utility from a particular candidate J is the utility the voter would anticipate, conditioned on their posterior distribution, is (Zechman 1978):

$$E(U(\theta_J) \mid P(\theta_J \mid \gamma_J, \eta_J)) \tag{7}$$

This leads to a decision making rule for the voter, that is, vote for candidate J instead of G iff:

$$E(U(\theta_J) \mid P(\theta_J \mid \gamma_J, \eta_J)) \geq E(U(\theta_G) \mid P(\theta_G \mid \gamma_G, \eta_G)) \tag{8}$$

Assume, as above, that the voter's posterior is distributed normally, with a mean and a variance (proportional to the precision), and that the distance between the voter and the candidate can be written in terms of a quadratic loss in utility. This implies that the voter will prefer candidate J iff $(\mu_{3J} - \omega_3)^2 \geq (\mu_{3G} - \omega_3)^2$, that is, if the posterior mean of candidate J is closer to their position (where the voter's position is denoted by ω) than the posterior mean of candidate G. By substituting from Equation 6 for each candidate, this gives an amended decision rule, vote for candidate J iff:

$$\left(\frac{\tau_{1J}\mu_{1J} + \tau_{2J}\mu_{2J}}{\tau_{1J} + \tau_{2J}} - \omega_3^2\right) \geq \left(\frac{\tau_{1G}\mu_{1G} + \tau_{2G}\mu_{2G}}{\tau_{1G} + \tau_{2G}} - \omega_3^2\right) \tag{9}$$

As complex as this might seem, interesting insights into the dynamics of voter preferences are obtained by analysis of the relationships between information, perceptions, and preferences in Equation 9. A very easy way to gain intuition into these relationships is again through simulations. The model in Equation 9 can be written probabilistically, and in that formulation, the relationship between the various elements of Equation 9 and the probability that a typical voter might support one of the candidates can be easily shown. First, to cast this model into a probabilistic format, we assume that the expected utility for candidate G is zero. Second, we assume that the non-issue components (denoted here by c_{iJ}) of the voter's evaluation of candidate J are distributed normally, and are independent of the voter's issue-based evaluation of the candidate.[7] These assumptions allow us to examine the voter learning model probabilistically. First, rearrange the terms:

$$\left(\frac{\tau_{1J}\mu_{1J} + \tau_{2J}\mu_{2J}}{\tau_{1J} + \tau_{2J}} - \omega_3^2\right) \geq 0 \tag{10}$$

$$I_{iJ} + c_{iJ} \geq 0, \tag{11}$$

where $I_{iJ} = \left(\frac{\tau_{1J}\mu_{1J} + \tau_{2J}\mu_{2J}}{\tau_{1J} + \tau_{2J}} - \omega_3^2\right)$. Then, under the assumption that c_{iJ} is distributed normally and independently of I_{iJ}, this expression can be written probabilistically:

$$P[I_{iJ} + c_{iJ} \geq 0] = \int_{\infty}^{I} \frac{1}{\sqrt{2\pi}} \exp^{\frac{-c^2}{2}} du \tag{12}$$

This presentation allows us to insert hypothetical values into this probabilistic model and to depict graphically the relationship between the uncertainty the voter has about the candidate's policy positions and the probability that the voter would support the candidate. Four such simulations were carried out, with two in the top panel of figure 2 and two in the bottom panel. Simulation values were identical to the previous simulations except where noted.

Figure 2 Goes Here

The x-axis in each panel of figure 2 gives the precision of the newly-encountered information, and the y-axis gives the *change* in probabilities of supporting the candidate once the new information has been assimilated by the voter. The new information the voter receives is that the candidate is closer to the voter on the issue than reflected in their prior knowledge. Two lines are plotted in each panel, one for a situation where the new information indicates that the candidate is much closer to the voter's position on the policy issue than the voter previously believed (dotted line), and one where the information states that the candidate is not much closer to the voter on the issue (dark line). The top panel presents these plots for a situation in which the voter's prior knowledge was *imprecise*, while the bottom panel gives the plots for a scenario in which the voter's prior knowledge was *precise*.

Comparison of the results of these simulations produces some interesting conclusions. First, in the top panel of figure 2 it is apparent that when the voter has an imprecise prior knowledge of the candidate's position, and receives new information that the candidate is closer to their ideal point, that relatively large changes in the voter's probability of supporting the candidate occur across a wide range of precisions of the new information. Compare the following two scenarios. First, the new information is very imprecise, with a precision near zero, and second, where the information is relatively precise, at a simulated value of approximately nine. In the first scenario, the probability that the voter supports the candidate does not change very much, no matter how close the candidate has moved to the voter's position, since their perception of the candidate's position is simply not very precise. However, in the second scenario, notice the wide divergence between the changes in probability of supporting the candidate where the candidate has moved much closer to the voter, relative to only slightly closer. As we might anticipate, when the prior information is imprecise, but the new information is precise, the voter adjusts their evaluation of the candidate weighing heavily the new information, evidenced by the large change in the probability of supporting the candidate, and these changes are greater when the information indicates that the candidate is closer to the voter on the issue.

But in the bottom panel of figure 2, where the prior information is much more precise, a different conclusion is apparent. Again, compare two scenarios, the first in which the voter's new knowledge is very imprecise (near zero), as compared to a situation in which the information obtained is relatively precise (near nine). Interestingly, in the first scenario, the voter is very unlikely to support the candidate — since their relatively precise prior states that they are not very near to the candidate on the issue, and very imprecise information does little to change this prior. Yet in the second scenario, there is a change in the likelihood that the voter would support the candidate (the difference in simulated probabilities is approximately 0.35 for the voter close to the candidate and around 0.05 for the voter further from the candidate), indicating that precise information can lead to a change in preferences when the new information is itself precise.

What is most interesting here, however, is the comparison between the figures. The conclusions when the new information obtained by the voter is very imprecise do not vary whether the candidate is near or far from the voter, or whether the priors are

precise or imprecise. But when the new information is precise, we do see a good deal of variation depending on the relative location of the candidate *and* the precision of the prior knowledge. In the two simulations where the voter is closer to the candidate, they are more likely to support the candidate when they obtain new and precise information about the candidate's position.

But when the prior information is less precise, and the information reveals that the candidate is much closer to the voter, the change in probabilities is drastically greater than when the prior information is more precise. New information — even relatively imprecise information — leads the voter to update their knowledge greatly and to even change their evaluation of the candidate, when prior information about the candidate's position is uncertain. However, when the voter's prior knowledge is more certain, new information — even relatively precise information — does not lead to a great deal of updated perceptions and does not result in relatively large changes in candidate evaluations.

2.2 Insights from the Voter Learning Model

The Bayesian learning model discussed in the previous section revealed some interesting implications for the way in which new information about a candidate's policy position might influence a voter's perception or misperception of a candidate's position and their evaluation of that candidate. Two general hypotheses follow from the discussion in the last section. First, *voters should update their perceptions of candidate issue stands when they obtain new information about those stands; thus the perceptions of voters should change when information about these stands becomes increasingly available during the campaign.* Second, *new information may lead voters to change their evaluations of the candidate in any case, but this is much more likely when prior information is very imprecise.*

Thus by incorporating *imperfect information* into an individual-level model of voter preferences and perceptions, the Bayesian approach yields insights into many of the past findings in the literature. We have shown that when presented with new information about the positions of the candidates on policy issues, voters should assimilate that information into their perceptions of the candidates' stands. This "learning" should occur on two levels: voters are expected to update, or change, their estimate of the candidate's position (the mean), as well as their uncertainty of the candidate's position (the precision). Therefore, when information is available, perceptual learning should occur in the electorate. Demonstrating this relationship, then, will show that campaigns can "matter."

Yet the voter learning model also implies that the effects of campaign learning should be most apparent in the perceptions or misperceptions of voters. Usually, in general elections at the presidential level, voters will have some, if not a great deal of prior knowledge of both candidates. In such a situation, the insights of the voter learning model are that we expect to see new information have little effect on the voter's perceptions

of the candidates' issue positions, but perhaps a larger effect on the certainty of their perception; additionally we would rarely expect a substantial change in their preferences. In this perspective, the "minimal effects" findings are really not so surprising — in presidential election, with incumbents fighting against well-known challengers, or even with nationally-prominent challengers contesting for an "open" seat, voters should have relatively precise priors even at the beginning of the general election season.

But different electoral contexts might produce different conclusions. For example, early in a presidential primary, when voter knowledge of the positions of the candidates is very uncertain, new information, even if it is also uncertain, can produce large changes in the voter's perceptions of the candidate's position, their uncertainty of that position, *and even in their preferences.* This provides a theoretical account for the volatility witnessed early in the primary season in voter preferences and perceptions. They have imprecise knowledge, and learning new information in an uncertain situation can have dramatic consequences.

So generally, we expect information to have different effects across the course of a presidential campaign. Early in the primary season, when knowledge is imprecise, a little new information can go a long way — even as far as changing a voter's preferences. But late in the general election, in the weeks before the general election, voters will typically have precise priors about the positions of the candidates. So even a lot of new information, even precise new information, will not induce a change in voter preferences. Late in the campaign, though, the major source of change should instead be in the precision of their beliefs; that is, in their certainty about the issue positions of candidates.

Thus, we focus on the effects of campaign information on voter perceptions of candidate issue positions. For voter learning about the issue stands of candidates to occur we must first demonstrate that information about candidate issue positions is made available to voters during political campaigns. Second, we must then show that there are corresponding changes in voter perceptions of candidate policy stands over the course of the campaign. And third, we must demonstrate that the information about candidate policy positions is received by voters and that it is used to update their perceptions of candidate policy stands. We test each of these propositions in the following sections of this paper.

3 Simple Tests of the Voter Learning Model

Do campaigns provide information to voters about the positions of the candidates? Do voter perceptions change over the course of the campaign? And can we say that voters learn about candidate issue positions during the campaign? To answer these questions, we focus on the 1976 and 1980 elections. Using data from Thomas Patterson's panel study and media content analysis from this election, and the 1980 NES Major Panel and our own content analysis of stories from the *Los Angeles Times*, we test the hypotheses derived from the voter learning model. For 1976 the panel study consisted of five waves,

beginning in January and repeated every two months up until the election. In 1980 the panel study consisted of three waves conducted in February, June, and September. Unfortunately, the last wave of the NES Panel Study was only a brief fifteen minute telephone interview which did not provide enough information about voter perceptions to be useful in our analysis.

In both of these panel studies a variety of opinion questions were asked of individuals. From questions about media exposure and the issue positions of candidates we can examine the effects of the campaign on individual perceptions of the candidates. First, to ascertain the perceptions that individuals had of the candidates in the presidential campaign we examined how informed they were in their placements of the candidates on seven point issue scales. In 1976 seven issue scales were presented to respondents in all five waves. These issues were defense spending, welfare programs, busing to achieve integrated schools, ideology, abortion, the distribution of a tax cut, and the government's role in providing jobs. In 1980 the five issues available for study were ideology, defense spending, government spending, inflation, and relations with the Soviet Union.

The measure of uncertainty we employ in this section is taken from Alvarez (1997). There have been two types of survey-based measures of uncertainty in the literature. First, there are the direct survey question approaches to measuring uncertainty (Aldrich et al. 1982; Alvarez 1997; Alvarez and Franklin 1994). In these attempts to probe voter uncertainty, survey questions are explicitly designed to probe uncertainty; some of these attempts have been quite successful (Alvarez and Franklin 1994). Second, there are indirect approaches. These rely upon the use of surrogate measures, which either serve as instruments for uncertainty (Bartels 1986; Franklin 1991), or as attempts to operationalize uncertainty from survey questions. Our measurement strategy takes the latter approach.

In our voter learning model, the voter's prior, newly-obtained, and posterior information were assumed to be distributed with a mean and a variance. Our approach relies upon operationalizing this variance in voter understandings of the policy positions of candidates, by measuring:

$$v_{iJ} = (P_{iJ} - T_J)^2 \tag{13}$$

where v_{iJ} represents voter i's uncertainty in their placement of candidate J on a policy dimension, P_{iJ} gives i's placement of J on the policy dimension, and T_J indicates the actual position of candidate J on the policy dimension in question.

This is a representation of the voter's uncertainty about the candidate's position across the policy space, in terms of the net dispersion of the voter's perception of the candidate's position and the candidate's true position. The greater the dispersion of their perceptions of the candidate's position from the candidate's true position (here measured by the mean placement of the candidate on each issue across the particular sample), the more uncertain they are about the candidate's position on the policy issues; the tighter this dispersion of points, the less uncertain they are about the candidate's position. If

a voter was unable to place a candidate on an issue scale, or did not recognize the candidate's name, then they were coded as maximally uncertain. Maximally uncertain voters were coded as if they had placed the candidate on the issue scale at the endpoint furthest from the mean.

This representation of voter uncertainty is appealing for three reasons. First, unlike the measures of uncertainty often employed in the literature, this representation directly operationalizes uncertainty from the survey data, and does not infer indirectly a uncertainty measure from ancillary information about respondents. Second, this measure meshes closely with the "precisions" as discussed in relation to the Bayesian model, which will allow for rigorous tests of the implications of that model. Third, this measure can be applied to existing survey data, particularly the historical data from the National Election Studies, where there are questions asking respondents to place candidates on policy scales. Note that the accuracy of this measure will depend on the accuracy of the questions used to measure both the voter's and the candidate's positions on the issue. However, without direct survey questions probing respondent uncertainty, this approach is quite attractive. Notice that our measure of uncertainty measures how accurate voters actually *are* in their placement of candidates on issue scales, rather than how certain they *feel* about their placement. However, past research has demonstrated a high degree of correlation between direct measures of uncertainty (or *subjective* uncertainty) and the measure of uncertainty employed here (which measures *objective* uncertainty).

As a first look at changes in uncertainty over the course of the campaign, we calculated the uncertainty measures for all candidates in the first and last waves of the panel study in both of the elections we study. Our measure of individual-level changes in uncertainty about the presidential candidates is simply the difference between the voter's uncertainty about the policy stands of each candidate at two different points in time; here the first and last survey waves. Rather than study the simple differences between each voter's uncertainty for the candidates over time, we have analyzed only those reductions in voter uncertainty which we deemed substantial. To determine substantial changes in voter uncertainty, we calculated the difference between the uncertainty measures in the first and last waves and the standard error of that difference. Changes between the two uncertainty measures at the individual-level were deemed substantial if they were greater or less than one standard deviation from zero. That is, positive changes greater than one standard deviation from zero were termed substantial increases in uncertainty, while negative changes greater than one standard deviation from zero were called substantial reductions in uncertainty.

We first calculated the uncertainty measure for Carter and Ford for the first and last waves of the 1976 Patterson panel survey (February and October). In tables 1 and 2 are shown the percentages of respondents with increased, decreased, or unchanged uncertainty about the policy positions of both candidates between the February and October waves of the panel study. The most striking observation in these tables is the high proportion of voters who reduced their uncertainty about Carter over the course of the campaign. On almost all issues, over 50% of respondents had substantial reductions

in their uncertainty about Carter's positions. Respondents who showed a substantial increase in uncertainty were always less than 3% of the sample on any issue. Substantial learning also took place when we turn our attention to Ford, although it was less dramatic than for Carter. About 70% of the sample remained within one standard deviation of zero, while about one-fifth of the sample experienced substantial reductions in uncertainty. Those who grew less certain of Ford's positions never comprised more than 10% of the sample.

Tables 1 and 2 Here

Such powerful evidence of voter learning in 1976 comes as no surprise, considering the obscurity of Carter at the beginning of the campaign and the fact that Ford was a nonelected incumbent who had not served a full term in office. This lack of information at the beginning of the campaign implied that voters would have imprecise priors about both candidates, and thus new information would have a large effect on voter uncertainty. Voters used new information to reduce their uncertainty about both candidates, but because voters held more information about the incumbent Ford at the start of the campaign, new information did not have the dramatic effect on voter uncertainty that was observed for Carter.

We conducted our analysis of the individual-level changes in voter uncertainty in the 1980 campaign using the same methodology as for the 1976 campaign. The individual-level changes in voter uncertainty across the entire campaign tables 3, 4, and 5 for Carter, Reagan and Anderson, respectively (however, the Anderson uncertainty changes are only computed for the last two waves of the 1980 study since issue placements for Anderson were not included in the first wave of the 1980 NES Panel Study). Note that very little voter learning took place for the incumbent Carter. Carter in 1980 is the only elected incumbent in our sample, and it appears that after three years in office, there was very little about him that voters didn't already know. The precise priors held by voters did not allow new information to have much (if any) effect on voter uncertainty. More evidence of voter learning exists for Reagan. About 70% of the sample had changes in uncertainty less than one standard deviation from zero, and about 20% experienced substantial reductions in uncertainty. Reagan was a much more prominent challenger in 1980 than Carter was in 1976, having pursued a career in acting and serving as governor of California. Thus it seems likely that voter's priors about Reagan in 1980 were more precise than they were for Carter in 1976, and so voter learning about the challenger was less dramatic than it was four years earlier.

Tables 3, 4 and 5 Here

The case of Anderson (Table 5) is interesting, as well. We see that on each issue there were at least 17% of the electorate who substantially reduced their uncertainty about Anderson's position; the overwhelming majority, though, were essentially unchanged in their uncertainty about Anderson's issue positions. This places Anderson above Carter,

since there was clearly less learning about Carter's issue position in 1980, but below Reagan, since there was more learning about Reagan's issue positions. However, keep in mind that the entries in Table 5 are different than those in Tables 3 and 4, since the 1980 NES did not ask Anderson issue placement questions in the first wave of the panel study. So, we are estimating changes in Anderson uncertainty from the second (post–primary) and third waves of the 1980 NES Panel Study; it is quite likely that we are measuring changes in uncertainty about Anderson's issue positions after many voters had learned a great deal about Anderson's positions.

It is apparent that voters were enjoying substantial reductions in their uncertainty about the candidate's issue positions during the course of both campaigns. However, it is still not clear if this reduction in uncertainty is in response to the political campaign, or some other factor. Thus, we must examine media coverage of the candidates as well as voter uncertainty if we are to draw a definitive link between the two. A precondition for voter learning is that the electorate must be presented with information during the campaign. To show that learning occurred regarding the uncertainty of the electorate about the positions of the candidates in 1976 and 1980, we must demonstrate that information about their positions was in fact transmitted during the election, and that voter perceptions responded to this information.

The volume of media coverage for a given candidate in a given wave was recorded as the number of "substantive" stories about that candidate's issue positions during that wave. A media story was coded as substantive if it directly relayed information about the candidates' issue positions. In 1976 the media data was obtained from a media content analysis conducted by Thomas Patterson concurrently with the panel study. The news content of both television and newspapers was analyzed throughout the course of the campaign for substantive content. In 1980 the media data was derived from a content analysis of the *Los Angeles Times*. Although information was often available for media coverage of candidates stands on specific issues, the lack of coverage of some issues in some waves would have necessitated dropping them from the study. Thus, we chose to examine the media environment at a more aggregated level and consider all substantive coverage of a candidate during a wave, creating a media volume variable that reflected the total number of substantive stories about each candidate in each wave.

To examine the information dynamics of the 1976 campaign we used Patterson's media content data. Patterson randomly selected over 6,500 politically related news stories concerning the 1976 election from nine mass media outlets, including newspapers, magazines, and television networks. Using this data, we first aggregated the reference topics during each month of the campaign following Patterson's guidelines: stories relating to evaluations of the candidate, strategies, tactics, logistics, support, campaign style, horserace, appearances, and chances for victory were grouped under the label "hoopla", while stories about the issue stands, ideologies, records, traits, and endorsements of the candidate were categorized as "substance." The results of this analysis for Carter and Ford are presented in figure 3.

Figure 3 Here

Carter begins the election with almost no substantive coverage (only 6%). This is not surprising, given that he was competing for substantive coverage with so many other, and better-known primary candidates from both parties. But with early successes, Carter's substantive coverage climbed to almost 30% of references in March through May, and reaches a peak of 62.9% in July before falling to about 40% during the general election months of September and October.

Ford, on the other hand, began with the lion's share of substantive coverage in January (30%), and continued to receive about one-fifth of all substantive coverage through July. But during August, and the Republican convention, substantive coverage of Ford jumped considerably, to 48% of the total. The seven issues available for study in 1976 comprised a large proportion of the substantive coverage of Carter and Ford, or about 26.29%.

We undertook our analysis of the media coverage of the 1980 race in the same way as for 1976. We undertook a content analysis of one major national newspaper — the *Los Angeles Times* — during the entire election year (January 1 through November 4). We attempted to replicate the story selection and coding content procedures outlined by the Patterson study as closely as possible. This produced 5523 specific "candidate mentions" (the relationship of a candidate to a specific topic) across the election year.

As in the 1976 media analysis, stories are aggregated into two categories, hoopla and substance, using the same coding guidelines as for 1976. The results of this analysis for Carter, Reagan, and Anderson are presented in figure 4. Carter receives almost a sheer majority of substantive coverage during the primary season - he gets approximately 50% of the substantive coverage through June, except for slightly less in February. As president and as the front-runner in his party's primary, Carter clearly enjoyed tremendous substantive coverage in the newspapers. Reagan, though, begins with little substantive coverage through May. ¿From May until July his substantive coverage skyrockets, and after a dip during the Democratic convention in August, it rises to 70% of candidate related substantive coverage in October and early November. But we also see that Anderson received very little substantive media coverage throughout the 1980 race. Only very early in the campaign season — in March — does he receive at least as much coverage as one of the other two major–party candidates. Otherwise, Anderson receives little substantive media coverage, especially in the general election campaign.

Figure 4 Here

Thus the prerequisites for voter learning were in place in both the 1976 and 1980 Presidential campaigns. Individuals had access to a great amount of substantive information about candidate issue positions through the media. Also, many individuals appear to have learned a great deal about the issue positions of the five candidates under scrutiny in our analysis. We established stringent conditions for a priori evidence of voter learning in the 1976 and 1980 presidential campaigns and the data presented in this section has shown that the conditions existed in both of these elections for voter learning to occur.

4 Multivariate Analysis of Voter Learning

However compelling this preliminary evidence is, the task of directly linking media exposure and coverage to reductions in voter uncertainty remains. To do so we turn to a multivariate analysis of voter learning, where the variables we wish to explain are each voter's level of uncertainty about a particular candidate's issue positions. Our model of voter learning posits that new information received by the voter will lead to reductions in their uncertainty. An important test of our model will be to examine the impact of new information on voter uncertainty, controlling for a series of alternative explanations for voter learning.

In order to examine the effects of political campaigns on voter uncertainty we wish to estimate the following equation for each candidate and issue:

$$\begin{aligned} \log U_{it} &= \alpha + \beta_1 * Subs_t + \beta_2 * Media_{it} + \beta_3 * (Media * Subs)_{it} + \\ &\quad \beta_4 * Rep_{it} + \beta_5 * Dem_{it} + \beta_6 * Talk_{it} + \beta_7 * Educ_i + \\ &\quad \beta_8 * Race_i + \beta_9 * Gender_i + \varepsilon_{it} \end{aligned} \tag{14}$$

In this model, U_{it} is the voter's uncertainty (measured as described in the previous section) about the position of one candidate on one issue in a particular wave of one of the panel studies; the dependent variable in the multivariate models is logged to give us a continuous and unbounded measure of voter uncertainty.[8] The most important right-hand side variables are $Subs_t$, $Media_{it}$ and $(Media * Subs)_{it}$; the first is the amount of substantive media coverage of the candidate on issues during the period under study, while the second is the individual's level of exposure to the media, and the third is the interaction between these two previous variables. The key predictions of our model of voter learning are that greater substantive coverage of the candidate's issue positions in the particular time period, if received by the voter, will lead that individual to be less uncertain about the positions of the candidate. In terms of the Bayesian learning model, $Subs_t$ represents new information about the candidate; as more information is made available to voters about the candidate in a particular wave (thus increasing the precision of the new information) we expect voter uncertainty to decline. This leads us to hypothesize that β_1 will be negative. Likewise, $Media_{it}$ represents the probability that a voter will receive the new information available. As media exposure increases so does the total amount of new information that the voter will be able to use to update; thus we hypothesize that β_2 will also be negative. Finally, we include the interactive term $(Media * Subs)_{it}$ to test for a non-linear relationship between information and voter learning; we hypothesize that β_3 will be negative.

A number of exogenous control variables often associated with political information and interest were also included. Race, gender, and education were all included in the analysis. Dummy variables to account for the party identification of the respondent were also included to filter out the potential effects of "partisan activation" (Lazarsfeld et

al. 1944). We hypothesise that individuals who indicate a partisan preference should have less uncertainty about candidates from their own party. Such individuals likely pay more attention to their own party's primary, and will likely have more interest in media coverage about their party's candidate. A dummy variable was also included for those individuals who stated that they frequently spoke with others about the candidates and the political campaign. We include this variable as a control for interest in the campaign, as individuals who are more interested in politics may make more of an effort to seek out information about the candidates. Note that substantive media coverage of a candidate does not depend on the individual respondent and is thus subscripted only by t, while education level, race and gender are invariant over time (or at least over the political campaign), and are thus subscripted only by i. [9]

For both 1976 and 1980 we have observations from N individuals over T time periods (the number of waves in the panel study), giving us a total of NT observations (minus any missing observations). This type of data configuration is commonly known as panel data. Panel data offers several advantages over cross-sectional or time series datasets. For instance, analysis of panel data could not only detect a 15% unemployment rate over time, but allow the researcher to determine whether this 15% unemployment rate represented a group that remained unemployed for long periods of time, or if the 15% unemployed was a constantly changing group over time. In the context of this study, analysis of the panel data from the 1980 NES Panel Study and the 1976 Patterson study will allow us to determine not only if voter uncertainty declines in response to political campaigns, but who is experiencing the reductions in uncertainty to a greater or lesser degree.

With N individuals observed over T time periods, the first temptation is to pool all observations and perform OLS on all NT observations. However, several strong assumptions are necessary in order for the pooled regression to be a valid statistical procedure. Specifically, in order for the pooled regression to be consistent and unbiased, we must assume that voter learning is generated by the same process for all individuals in all time periods. The assumption that the regression parameters take values common to all individuals in all time periods is an exceedingly strong homogeneity assumption, and amounts to assuming that all individuals learn at the same rate in every time period. Clearly such an assumption is unrealistic. As we do not wish to assume homogeneous parameters across individuals and over time, we must employ a model that explicitly accounts for heterogeneous parameters. One model that meets our needs is the random-effects (or error-components) model.[10]

Consider the model

$$y_{it} = \alpha + x_{it}\beta + \omega_{it} \tag{15}$$

If there are individual-specific effects that we have not captured explicitly in our model, we can decompose the error term into an individual-specific component and the

"usual" error term commonly assumed in OLS estimation. That is, $\omega_{it} = \nu_i + \varepsilon_{it}$. Therefore, all individual-specific sources of parameter heterogeneity are captured in the residual. ν_i differs across individuals, but is constant for any particular individual. In this context, ν_i captures unobserved attributes of the individual that affect voter learning.

We can represent (15) in terms of its individual means by

$$\bar{y}_i = \alpha + \bar{x}_i\beta + \nu_i + \bar{\varepsilon}_i \tag{16}$$

where $\bar{y}_i = \sum_t y_{it}/T_i$, $\bar{x}_i = \sum_t x_{it}/T_i$, and $\bar{\varepsilon}_i = \sum_t \varepsilon_{it}/T_i$. Subtracting (16) from (15) gives us (15) in terms of deviations from its individual means, which is

$$(y_{it} - \bar{y}_i) = (x_{it} - \bar{x}_i)\beta + (\varepsilon_{it} - \bar{\varepsilon}_i) \tag{17}$$

Equations (16) and (17) are the source of the random-effects model. Estimating equation (16) by OLS is known as the between estimator, for it estimates β by making use of the variation between individuals in each time period. Estimation of equation (17) by OLS is known as the within estimator, and estimates β by making use of variation within each individual's behavior over time. The random-effects estimator is a matrix weighted average of the within and between estimators, and is equivalent to estimating

$$(y_{it} - \bar{y}_i\theta) = (1-\theta)\alpha + (x_{it} - \theta\bar{x}_i)\beta + [(1-\theta)\nu_i + (\varepsilon_{it} - \bar{\varepsilon}_i)] \tag{18}$$

where $\theta = 1 - \sqrt{\frac{\sigma_\varepsilon^2}{\sigma_\varepsilon^2 + T\sigma_\nu^2}}$. If $\sigma_\nu^2 = 0$ meaning ($\nu_i = 0$ for every individual), then $\theta = 0$, and equation (14) can be estimated directly by OLS. However, if θ is non-zero then estimating (14) by OLS will yield biased and inconsistent estimates of β.

A simple specification test for the use of the random effects model is the Breusch-Pagan test, which is a test of $H_0 : \sigma_\nu^2 = 0$. Rejection of the null hypothesis indicates that significant individual-specific sources of heterogeneity are present, and that a random-effects model is an appropriate specification of our model. In all of the models estimated in the following section the Breusch-Pagan test rejected the null of no individual-specific heterogeneity at the $p = 0.0001$ level.[11][12]

5 Information and Voter Learning

The random effects model outlined above was estimated for each of the major candidates in both 1976 and 1980. As discussed earlier, 1976 is a year in which we could expect to see dramatic campaign effects due to the relative obscurity of the candidates. Voters held little information about Carter and Ford at the beginning of the 1976 campaign,

meaning that voters likely had weak prior beliefs about both candidates' issue positions. These weak priors mean that even a small amount of information could lead to large reductions in voter uncertainty. Tables 6 and 7 present the results of the estimation of the random effects model for both Ford and Carter.

Tables 6 and 7 go here

Notice that our hypothesis about the relative strengths of priors held by voters about that candidates is reflected in the constant term. The larger constant values in the models involving Carter indicate a greater degree of initial uncertainty held by voters with regard to Carter relative to Ford. Thus we expect to see more learning effects for the Carter campaign in 1976 than in the Ford campaign. To understand this we must recall the Bayesian learning model. Figure 1 illustrates the changes in voter uncertainty in the face of new information over several precisions of priors. As priors grow more precise, the same amount of information will have less effect on voter uncertainty, all else equal. Therefore, the weaker priors voters held with regard to Carter relative to Ford indicates that learning effects will be stronger for Carter's issue positions.

It is apparent from examination of the three variables that pertain to the campaign (the level of substantive coverage, the level of media exposure, and the interaction between these two variables) that the presidential campaign of 1976 had an impact on individual perceptions both candidates involved. Turning first to substantive coverage of candidates, we observe dramatic changes in respondent uncertainty in response to increased substantive coverage. The weak priors that voters held about Carter meant that new information lead to significant updating of individual beliefs about Carter's issue positions. Thus the level of substantive coverage takes on negative and highly significant values across all issues for Carter. The effects are less dramatic in the case of the Ford campaign due to stronger voter priors, but increasing information still reduced voter uncertainty about Ford's positions on defense spending, busing, and the role of the government in providing jobs. At first glance the coefficients on the level of substantive coverage may appear to be miniscule; however, one must recall that our dependent variable is logged uncertainty. Thus, a coefficient of -0.01 on substantive coverage represents a large decrease in uncertainty over the course of one wave of the panel study, particularly when one considers that the level of substantive coverage in most waves for most candidates was well over 50 stories[13]

Media exposure also emerges as a significant factor in reducing voter uncertainty over the course of the campaign. The coefficient for the level of media exposure always took on a negative sign, and was significant for 5 of 7 issues for Carter, and 4 of 7 issues for Ford. Obviously, increased media exposure allowed individuals to observe more of the substantive coverage that was available about the candidates, and thus facilitated learning. This seems especially likely in light of the insignificance of the interaction term between the level of substantive coverage and the level of media exposure. It seems that it is the sheer volume of information that an individual is exposed to that

accounts for learning about candidate issue positions; learning and information have a linear relationship.

Among the control variables, education, talking with others about politics, and gender emerge as significant factors in explaining voter learning. Turning first to education, we see that higher levels of education allowed individuals to greatly reduce their uncertainty over the course of the campaign; in fact, education was the single largest factor contributing to voter learning in both the 1976 and 1980 campaigns. Increased education reduces the cost to an individual of gathering and interpreting information (Popkin 1991, Alvarez 1997). The reduced costs of information due to education are apparent in these results. Those who engaged in political conversations with others enjoyed similar reductions in their uncertainty. It seems likely that this variable represents both interest in the campaign and an additional source of information. The higher costs of information to women in electoral campaigns is also reflected in these results. For both Carter and Ford women experienced much more uncertainty about the candidate's issue positions than did men. Interestingly, minorities, regarded as another subset of the electorate with higher information costs, did not seem to experience much more uncertainty than the population as a whole. Finally, our results reveal that there were almost no partisan effects on learning about candidate issue positions in 1976.

The 1980 presidential campaign was a very different environment for voters than the one in 1976. Reagan and Carter were better known to voters at the start of the 1980 Presidential campaign than Carter and Ford were at the same point in 1976, and thus we expect voters to hold stronger priors about candidate issue positions in 1980 than in 1976. Thus, the effects of the campaign on voter learning for the major party candidates in 1980 will likely be less dramatic than in 1976. But in the 1980 campaign we also have a minor party candidate, John Anderson, whom most voters ought to have very diffuse prior beliefs about. So we do expect to see evidence of voter learning about the issue positions of Anderson, since most voters likely began the campaign relatively poorly informed about his issue positions. The random effects model was estimated for Carter, Reagan, and Anderson in 1980; these results are given in Tables 8, 9 and 10.[14]

Tables 8, 9 and 10 here

As in 1976, we see that the constant terms in the models we estimate for each candidate reflect the strength of the prior beliefs that voters hold about each candidate's issue positions. Carter, as the incumbent about whom voters hold the strongest priors, has the smallest constant terms relative to Reagan and Anderson. Likewise, the relatively small constant terms for Reagan in comparison with Anderson indicate that of the two challengers, it was Reagan who's issue positions were better known to voters. In terms of the Bayesian learning model, we expect to see little in the way of reductions in voter uncertainty for Carter, with greater learning effects for Reagan and Anderson.

Examining the variables that pertain to the political campaign in light of the priors that voters held about the candidates is revealing. For Carter, the political campaign

appeared to have little effect in reducing voter uncertainty. Despite high levels of substantive coverage regarding Carter's issue positions throughout the course of the campaign, voter uncertainty does not appear to significantly decline in response to new information about Carter's issue positions. This is in line with the predictions of the Bayesian voting model, and explains the lack of significance of the level of substantive coverage and the level of media exposure in the regressions involving Carter.

Much more voter learning is apparent when we turn to Reagan. The level of substantive coverage is of the predicted sign and statistically significant across all issues. Further, increased media exposure also contributes significantly to reducing uncertainty in 4 of 5 issues. Thus the evidence of voter learning for Reagan in 1980 closely resembles that of Carter in 1976, as less precise priors allow new information to play a greater role in shaping voter beliefs about Reagan's issue positions.

Interestingly, the reductions in uncertainty brought about by the Anderson campaign seem to be less than those induced by the Reagan campaign, even though voters likely held much weaker prior beliefs about Anderson. This is despite the fact that the coefficients on substantive coverage are negative and statistically significant across all issues for Anderson. Further, the magnitude of these coefficients is much larger than that for any other candidate, with the exception of some issues for Carter in 1976. This indicates that a given increase in substantive coverage reduced uncertainty further for Anderson than it would for any other candidate. However, the level of media exposure for individuals only has a significant effect on reducing uncertainty for Anderson's position on the level of government spending. This, coupled with the relatively low level of substantive coverage afforded Anderson over the course of the campaign, meant that voter uncertainty about Anderson's issue positions was high even on election day. Although voter priors about Anderson were weak, the lack of information available about Anderson's issue positions during the campaign meant that voter uncertainty remained high.

The control variables in 1980 had much the same effect as they did in 1976, with increased education and engaging in political conversations resulting in lower uncertainty about candidate issue positions. Women continued to experience an informational disadvantage in 1980. Further, minorities experienced the same disadvantage, displaying greater uncertainty in 1980 than they did in 1976.

Another interesting difference in the 1980 campaign as compared to the 1976 campaign is the role of partisanship. Partisanship played a role in voter learning about ideology, as Democrats grew more certain about Carter's ideology and Republicans grew more certain about Reagan's ideology. Further, Republicans reduced their uncertainty further about Reagan's positions on other issues when compared to independents and Democrats. No partisan effects were detected for the Anderson campaign. The 1980 presidential campaign was much more partisan than in 1976; it seems likely that the partisan effects observed here indicate partisan activation (Lazarsfeld et al. 1944), as Republicans and Democrats began to pay greater attention to the presidential campaign and their favored candidate in particular. Anderson, as an independent candidate, did not enjoy greater

attention due to partisan activation.

6 Discussion

It is clear from this analysis that voters did learn about the policy positions of candidates in both the 1976 and 1980 presidential campaigns. We demonstrated that many voters did have substantial reductions in their uncertainty of candidate issue positions; especially for candidates who were challenging incumbents. Secondly, we showed that there was a substantial flow of substantive information during each campaign. Last, our random effects panel models directly linked the information flow with the changes in voter uncertainty.

However, we have only tested one aspect of the voter learning model presented above — how the campaign information flow influences the certainty of voter knowledge of candidate issue positions. Two aspects of the voter learning model remain to be examined. The first is to look carefully at how the changes in voter uncertainty during the course of campaigns itself influences voter preferences. If voters are risk averse, and they discount candidates whom they are uncertain about, then we should see that the changes in voter uncertainty about the issue positions of particular candidates should lead to corresponding changes in voter preferences. Second, the same changes in campaign information flow should also be producing changes in voter perceptions of candidate positions on the issues, changing not only their *certainty* about where a candidate stands, but their perception of *where* that candidate stands. These impacts of the campaign information flow also need examination, since they are the second way in which candidates can influence voter preferences through their campaigns.

Nevertheless, this paper represents a step forward in examining the effects of political campaigns on voters. We conclude that voters are able to use new information gathered during the course of a campaign to reduce their uncertainty about the issue positions of the candidates, with the rate of learning about each candidate dependent on the amount and precision of the new information available about that candidate, and on the precision of previous information held about that candidate. We observed a very high rate of learning for Carter in 1976, when he began the campaign as a virtual unknown. This situation was reversed four years later, when Carter began the 1980 campaign as the incumbent president. In both campaigns the amount of substantive information available about Carter was tremendous, but only the imprecise priors held by voters about Carter in 1976 allowed for high levels of voter learning.

This leads us to assert that presidential campaigns do influence the electorate, especially when the conditions are conducive for voters to learn about the policy positions of the candidates. In our analysis here, we have identified two of these conditions: that voters have relatively imprecise prior understandings of where candidates stand on policy issues, and that the media provide substantive coverage of the campaign. Although our datasets provide us with several different levels of prior precision, substantive media

coverage of the candidates is almost always high. Thus, to better understand the role of media coverage in voter learning other types of elections must be studied, elections where the level of media coverage is more likely to vary from the massive amount of information provided during presidential campaigns.

Although the role of the media in voter learning cannot be completely understood through the study of presidential campaigns, we undoubtedly find evidence of voter learning in this environment. Why do our results differ from those typically found in the literature (e.g., Finkel 1993)? The answer, we believe, is that the model of learning we use in this paper leads us to look for voter learning in places which haven't previously been examined — instead of looking at whether the preferences of voters for specific candidates change over the course of a campaign, we look for changes in the information that voters have about the positions of candidates on policy issues. While changes in knowledge of candidate positions on issues can ultimately lead to changes in voter preferences, we believe that by not examining what voters know about the candidates previous work has unfairly biased their results towards finding that campaigns "don't matter."

Notes

[1]A similar argument is advanced in Alvarez and Franklin (1994).

[2]Many believe Bayesian learning models to be of little utility in the analysis of perceptual formation and change. But the Bayesian model actually complements the psychological learning models which have become popular in the political science literature. Where the cognitive-psychological models have presented very complete descriptions of the structures of past political information, whether they are termed scripts, schemas, stereotypes, or whatever else, these models have been less descriptive as to the processes by which new information is incorporated into these cognitive structures (some attempts have been made in this literature to overcome this tendency; see Conover and Feldman 1989; Lodge and Hamill 1986; Lodge, McGraw and Stroh 1989). While Bayesian models are less descriptive in the structuring of past information, they are more rigorous in the description of how newly-encountered information can be combined with old knowledge for updated assessments of the political world. See Achen (1992) for additional discussion.

[3]Here we have assumed the normal distribution for simplicity. Other distributions can be used in this model (DeGroot 1970). Also, we have assumed that the information the voter receives is costless. Future development of this learning model, incorporating costly information, is clearly necessary.

[4]Derivations of this step are in Zechman 1978, Appendix A, as well as in Judge et al. 1988, Chapter 4, and in most references on decision theory (Berger 1985; DeGroot 1970; Jones 1977).

[5]Since the variances of these distributions are assumed to be positive, so are the precisions. Under such conditions, the precision of the posterior will never be less than the precision of the prior.

[6]The incorporation of the updated knowledge of the candidate's position into the spatial model is relatively simple to demonstrate. More exhaustive discussions are in Calvert (1980) and Zechman (1978). Discussion of the standard spatial model of the sort we employ here is found in Enelow and Hinich (1984).

[7]Note that these assumptions are only required to demonstrate this theoretical model probabilistically, and are not relevant in subsequent empirical evaluation of the model.

[8]Our initial measure of uncertainty is bounded below at zero; taking the log of this variable creates a continuous unbounded measure of uncertainty that is more amenable to regression analysis.

[9]The details of coding of each variable are as follows. Media exposure for each respondent was constructed from respondent answers to two questions dealing with the type

and frequency of media exposure. In both the NES and Patterson studies respondents were asked if they watch network news every evening, 3 or 4 times a week, once or twice a week, or less often. These responses were recoded to a zero-one scale, with one indicating the most network news exposure. A dichotomous variable was also included to indicate reading of a daily newspaper. This variable was coded one if an individual did read a daily newspaper, and zero otherwise. This question was omitted from the third wave of the NES Panel Study, but was included in the post-election wave conducted two months later. Newspaper reading appears to be a behavior that remains stable over time (Bartels 1993), and so responses to the post-election wave question were used as proxies for the missing data. The network news and newspaper variables were added together to create the media exposure variable used in subsequent analysis. Education was coded on a zero-one scale, with 1 indicating the highest level of education (respondents were placed in one of four categories; less than high school education, high school diploma, some college, and college graduates). Gender is coded as 1 for female and 0 for male, and race is coded 1 for African-American respondents and 0 for all others. Dummy variables (*Rep* and *Dem*) indicate respondents who consider themselves Republicans or Democrats. Finally, a dichotomous variable was included to indicate those who talk about politics with others, and was coded 1 for those individuals who did engage in political discussions.

[10]Another model often employed in similar situations is the fixed-effects model, $y_i = \alpha_i + x_{it}\beta + \varepsilon_{it}$, where α_i captures the unobserved individual-specific effects that enter into voter learning. However, this model does not allow us to estimate coefficients for our time-invariant parameters (race, gender, and education), because α_i captures the effect of all such variables. Further, a random-effects model is more appropriate for our particular case, since our data are a random sampling of a larger population, and thus estimating constants specific to individuals in the sample would have little substantive meaning.

[11]Tables of these results are available from the authors.

[12]Another specification test often employed to test for the use of the random effects model is the Hausman test. The between estimator in the random effects model requires that we assume ν_i and $\bar{x}_i$ are uncorrelated. The null hypothesis of the Hausman test is $E(\nu_i|x_{it}) = 0$; it is a test of the zero-correlation assumption we make to estimate the between estimator. Rejection of the null hypothesis indicates that there is correlation between our individual-specific error term and our independent variables (probably due to omitted variables) that could induce bias in our estimates. The Hausman test rejects the null hypothesis for most of our models, with most of the acceptances falling on the incumbent candidates (Ford in 1976 and Carter in 1980). This indicates that weaker voter priors allow other factors to enter into learning about candidate issue positions. Unfortunately, there is little further information available in our datasets that could be used as instruments (Hausman and Taylor 1981). The usual correction in this case is to estimate a fixed effects model rather than a random effects model; we reject this option for reasons explained in endnote 10. Essentially, estimating a fixed effects model in this case would merely drop all of the independent variables that are correlated with

ν_i from the model. Thus, in light of the limited amount of information available in this survey data and our desire to estimate a model that includes time-invariant variables, we estimate a random effects model with the understanding that some degree of bias is inevitable in this case.

[13]If a candidate's true position on an issue was 3.5, and the coefficient on substantive coverage was -0.01, and a respondent began the wave believing that the candidate's position was at 5, then 95 substantive stories would be enough information for this respondent to update their beliefs about the candidate's position to 4, all else equal.

[14]Since issue positions for Anderson were not included in the first wave of the 1980 NES Panel Study, we are only estimating the random effects model on the second two waves of this study in Table 10.

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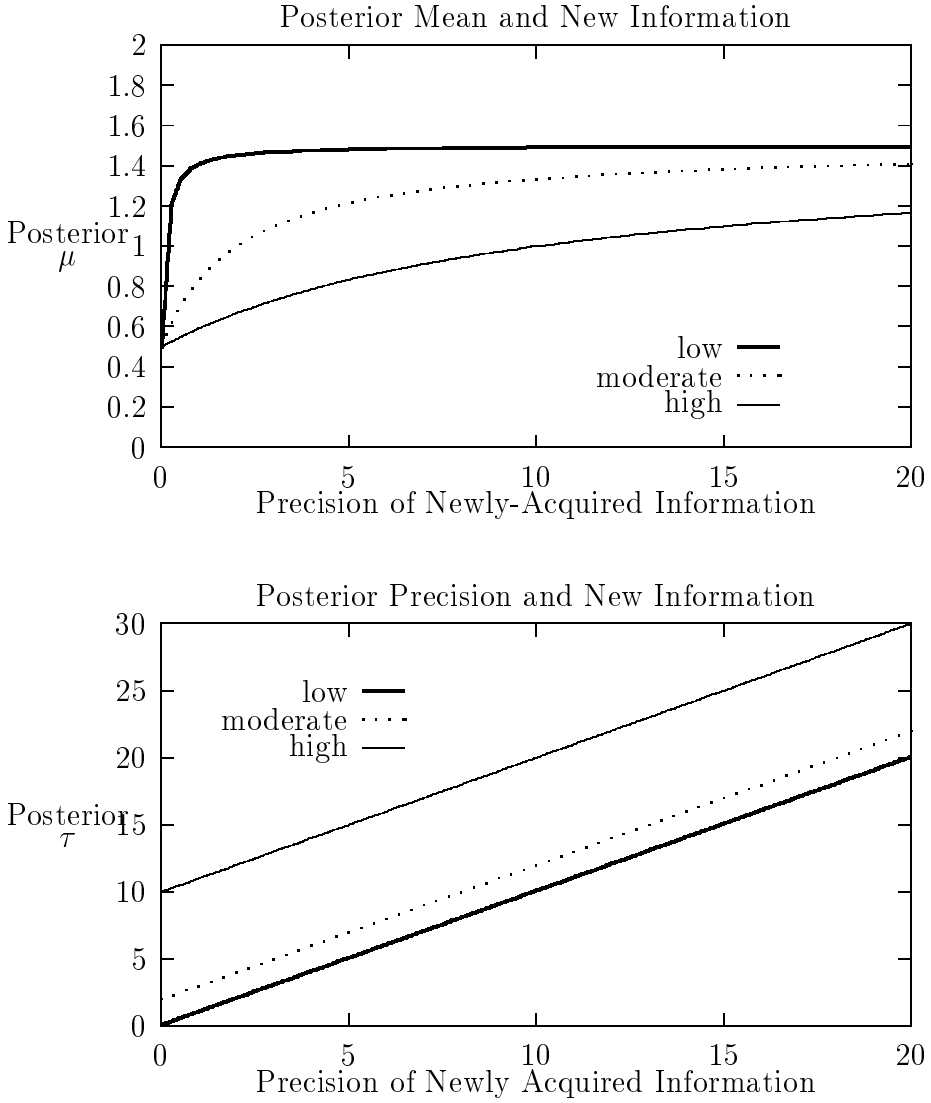
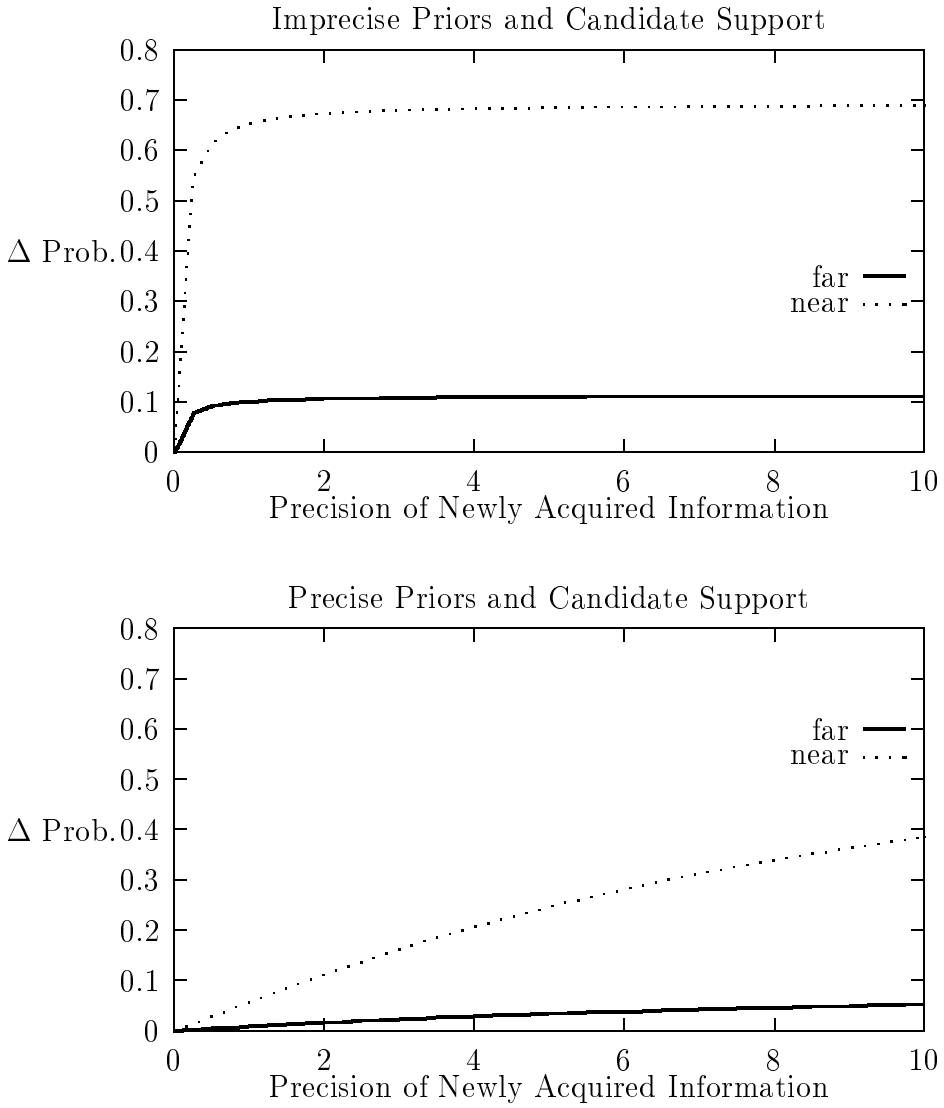
Figure 1: Voter Learning: New Information About a Candidate's Position



Note: Each panel shows the effect of new information about the candidate's position, across the range of precisions of the new information (given on the x-axis). The three levels of a voter's prior precisions of a candidate's position (low, moderate, high), are given by each line. The top panel gives the effects of the new information on the voter's posterior mean, the bottom on the posterior precision.

Figure 2: New Information and Changes in Voter Preferences



Note: Each panel shows the effect of new information about the candidate's position, across the range of precisions of the new information (given on the x-axis). The dark line in each panel depicts new information which indicates that the candidate not much closer to the voter; the dotted line information that the candidate is much closer to the voter. The top panel shows a simulation where the voter's prior was imprecise, and the bottom panel where the voter's prior was precise.

Figure 3: Substantive Media Coverage, 1976

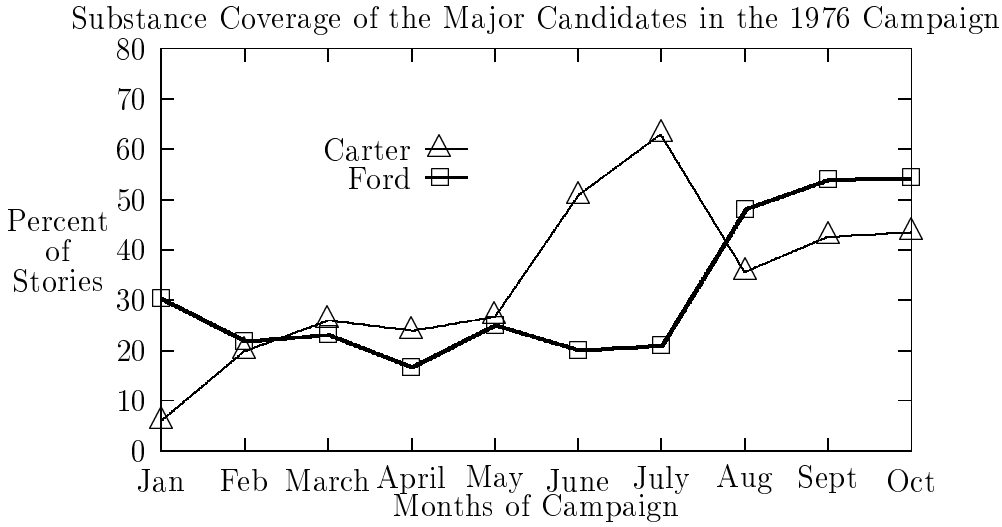


Figure 4: Substantive Media Coverage, 1980

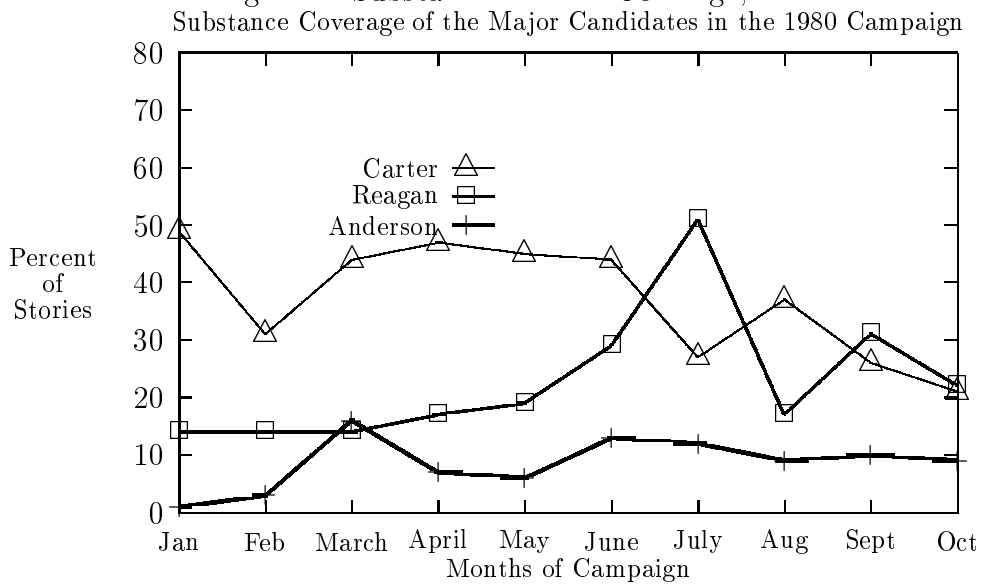


Table 1: Changes in Carter Uncertainty Across the 1976 Campaign

	Uncertainty of Carter's Positions		
Issue	Reduction	Constant	Increased
Ideology	60.8	38.3	0.9
	(389)	(245)	(6)
Defense	51.8	47.1	1.1
	(329)	(299)	(7)
Busing	46.1	51.9	2.0
	(295)	(332)	(13)
Welfare	53.8	43.7	2.5
	(344)	(279)	(16)
Abortion	54.7	43.9	1.4
	(346)	(278)	(9)
Tax Cuts	60.6	38.7	0.8
	(387)	(247)	(5)
Gov't Jobs	59.9	38.9	1.3
	(382)	(248)	(8)

Table 2: Changes in Ford Uncertainty Across the 1976 Campaign

	Uncertainty of Ford's Positions		
Issue	Reduction	Constant	Increased
Ideology	16.0	77.3	6.7
	(102)	(494)	(43)
Defense	23.1	70.3	6.6
	(148)	(450)	(42)
Busing	22.7	67.2	10.0
	(145)	(429)	(64)
Welfare	19.3	70.8	9.9
	(123)	(452)	(63)
Abortion	29.6	62.2	8.1
	(190)	(399)	(52)
Tax Cuts	22.3	69.1	8.6
	(143)	(443)	(55)
Gov't Jobs	22.2	69.6	8.1
	(142)	(445)	(52)

Table 3: Changes in Carter Uncertainty Across the 1980 Campaign

	Uncertainty of Carter's Positions		
Issue	Reduction	Constant	Increased
Defense	13.1	81.1	5.8
	(79)	(490)	(35)
Gov't Spend	8.0	78.3	13.7
	(44)	(433)	(76)
USSR	20.5	69.5	10.0
	(128)	(433)	(62)
Inflation	11.0	75.3	13.6
	(42)	(287)	(52)
Ideology	11.0	78.0	11.0
	(48)	(341)	(48)

Table 4: Changes in Reagan Uncertainty Across the 1980 Campaign

	Uncertainty of Reagans's Positions		
Issue	Reduction	Constant	Increased
Defense	27.0	67.6	5.4
	(169)	(423)	(34)
Gov't Spend	23.0	70.1	6.9
	(127)	(386)	(38)
USSR	22.1	70.9	7.0
	(142)	(455)	(45)
Inflation	23.4	69.6	7.1
	(96)	(286)	(29)
Ideology	15.2	80.4	4.3
	(70)	(370)	(20)

Table 5: Changes in Anderson Uncertainty Across the 1980 Campaign

	Uncertainty of Anderson's Positions		
Issue	Reduction	Constant	Increased
Defense	22.5	71.3	6.2
	(130)	(412)	(26)
Gov't Spend	17.5	73.9	8.7
	(119)	(503)	(59)
USSR	17.4	75.8	6.8
	(113)	(492)	(44)
Inflation	17.0	73.7	9.3
	(112)	(484)	(9.3)
Ideology	17.0	73.5	9.5
	(90)	(388)	(50)

Table 6: Ford 1976

	Ideology	Defense	Busing	Welfare	Abortion	Tax Cuts	Gov't Jobs
Constant	0.79**	1.80**	1.81**	1.19**	1.29**	1.31**	1.00**
	(0.18)	(0.14)	(0.20)	(0.17)	(0.18)	(0.13)	(0.18)
Subs Cov	0.003	-0.009**	-0.016**	-0.001	0.0004	-0.002	-0.009**
	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Media Exp	-0.13	-0.20*	-0.23*	-0.41**	-0.27**	-0.12	-0.19
	(0.09)	(0.08)	(0.11)	(0.10)	(0.10)	(0.07)	(0.10)
Med*Subs	0.0002	0.0008	0.0004	0.002	-0.0003	0.0001	0.002
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)
Rep	0.08	-0.05	-0.07	-0.08	0.15	0.09	-0.18
	(0.11)	(0.09)	(0.12)	(0.11)	(0.12)	(0.08)	(0.11)
Dem	0.05	-0.01	0.18	0.05	0.004	0.03	0.12
	(0.10)	(0.08)	(0.11)	(0.09)	(0.10)	(0.07)	(0.10)
Talk	-0.37**	-0.44**	-0.52**	-0.44**	-0.37**	-0.39**	-0.32**
	(0.12)	(0.10)	(0.13)	(0.12)	(0.13)	(0.09)	(0.12)
Education	-0.90**	-0.85**	-1.46**	-0.89**	-0.86**	-0.69**	-1.47**
	(0.14)	(0.10)	(0.13)	(0.12)	(0.14)	(0.10)	(0.13)
Race	0.44*	-0.03	-0.03	0.13	0.20	0.24	0.38*
	(0.18)	(0.13)	(0.17)	(0.15)	(0.16)	(0.12)	(0.17)
Female	0.41**	0.41**	0.58**	0.38**	0.41**	0.37**	0.34**
	(0.09)	(0.07)	(0.09)	(0.08)	(0.09)	(0.06)	(0.09)
Obs	4096	4097	4098	4094	4097	4097	4095
N	1175	1175	1176	1174	1176	1173	1175
R-squared	0.05	0.08	0.11	0.05	0.04	0.06	0.08

Note: * indicates significance at the 5% level, ** indicates significance at the 1% level

Table 7: Carter 1976

	Ideology	Defense	Busing	Welfare	Abortion	Tax Cuts	Gov't Jobs
Constant	2.23**	2.54**	1.92**	2.18**	2.43**	2.71**	2.24**
	(0.11)	(0.13)	(0.15)	(0.16)	(0.18)	(0.16)	(0.14)
Subs Cov	-0.01**	-0.01**	-0.007**	-0.008**	-0.02**	-0.02**	-0.02**
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Media Exp	-0.15*	-0.20*	-0.20*	-0.34**	-0.13	-0.15	-0.25**
	(0.06)	(0.08)	(0.08)	(0.09)	(0.10)	(0.09)	(0.07)
Med*Subs	0.0003	-0.002	-0.0001	0.001	-0.002	0.001	0.002*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
Rep	0.14	0.07	0.17	0.13	0.03	0.32**	0.17
	(0.07)	(0.08)	(0.09)	(0.10)	(0.11)	(0.10)	(0.09)
Dem	-0.02	-0.06	0.05	-0.06	-0.07	0.08	-0.06
	(0.06)	(0.07)	(0.08)	(0.09)	(0.09)	(0.08)	(0.08)
Talk	-0.52**	-0.66**	-0.67**	-0.66**	-0.61**	-0.83**	-0.60**
	(0.08)	(0.09)	(0.10)	(0.11)	(0.12)	(0.11)	(0.10)
Education	-0.77**	-1.01**	-0.92**	-0.86**	-0.61**	-1.05**	-1.19**
	(0.08)	(0.09)	(0.10)	(0.10)	(0.12)	(0.10)	(0.10)
Race	0.08	-0.15	0.01	0.17	-0.21	0.09	-0.01
	(0.10)	(0.11)	(0.13)	(0.13)	(0.15)	(0.13)	(0.13)
Female	0.35**	0.38**	0.41**	0.32**	0.31**	0.36**	0.32**
	(0.05)	(0.06)	(0.07)	(0.07)	(0.08)	(0.07)	(0.07)
Obs	4102	4099	4096	4097	4089	4100	4098
N	1177	1176	1176	1175	1176	1176	1177
R-squared	0.12	0.14	0.08	0.06	0.11	0.15	0.16

Note: * indicates significance at the 5% level, ** indicates significance at the 1% level

Table 8: Carter 1980

	Defense	Gov't Spend	USSR	Inflation	Ideology
Constant	1.01*	1.20**	-0.66	0.38	0.51
	(0.42)	(0.46)	(0.41)	(0.28)	(0.43)
Subs Cov	-0.002	-0.003*	0.003*	0.0003	-0.0003
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Media Exp	0.31	-0.07	-0.21	0.45*	0.48
	(0.28)	(0.32)	(0.28)	(0.19)	(0.30)
Med*Subs	-0.001	-0.0001	0.0001	-0.001*	-0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Rep	-0.02	0.02	-0.19	-0.02	0.02
	(0.14)	(0.14)	(0.14)	(0.09)	(0.14)
Dem	-0.09	-0.14	-0.13	0.15	-0.30*
	(0.13)	(0.13)	(0.13)	(0.09)	(0.13)
Talk	-0.33**	-0.23*	-0.18	-0.22**	-0.20
	(0.11)	(0.11)	(0.11)	(0.07)	(0.11)
Education	-0.93**	-1.11**	-0.73**	-0.39**	-0.84**
	(0.19)	(0.17)	(0.17)	(0.11)	(0.17)
Race	0.27	0.69**	0.44*	0.25	0.26
	(0.21)	(0.20)	(0.20)	(0.13)	(0.18)
Female	0.11	0.23*	0.47**	0.15*	0.32**
	(0.12)	(0.11)	(0.11)	(0.08)	(0.11)
Obs	1743	2193	2099	2215	1737
N	814	942	937	944	857
R-squared	0.05	0.05	0.05	0.03	0.04

Note: * indicates significance at the 5% level, ** indicates significance at the 1% level

Table 9: Reagan 1980

	Defense	Gov't Spend	USSR	Inflation	Ideology
Constant	1.23**	1.51**	1.54**	1.81**	1.76**
	(0.23)	(0.26)	(0.16)	(0.16)	(0.18)
Subs Cov	-0.002*	-0.002*	-0.002**	-0.003**	-0.002**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Media Exp	-0.27*	-0.37*	-0.28**	-0.32**	-0.19
	(0.13)	(0.16)	(0.10)	(0.10)	(0.11)
Med*Subs	-0.0003	0.001	0.0004	0.001	0.0000
	(0.001)	(0.001)	(0.0004)	(0.0004)	(0.001)
Rep	-0.29*	-0.54**	-0.09	-0.05	-0.24*
	(0.14)	(0.15)	(0.10)	(0.10)	(0.11)
Dem	0.17	-0.02	0.06	0.05	0.01
	(0.12)	(0.14)	(0.09)	(0.09)	(0.11)
Talk	-0.32**	-0.54**	-0.19*	-0.34**	-0.32**
	(0.10)	(0.12)	(0.07)	(0.07)	(0.08)
Education	-0.60**	-1.04**	-0.62**	-0.67**	-0.76**
	(0.18)	(0.19)	(0.12)	(0.12)	(0.13)
Race	0.57**	0.43*	0.23	0.19	0.03
	(0.20)	(0.22)	(0.14)	(0.14)	(0.14)
Female	0.40**	0.60**	0.41**	0.44**	0.29**
	(0.12)	(0.13)	(0.08)	(0.08)	(0.09)
Obs	1844	2256	2163	2263	1825
N	861	961	960	959	893
R-squared	0.07	0.08	0.08	0.09	0.09

Note: * indicates significance at the 5% level, ** indicates significance at the 1% level

Table 10: Anderson 1980

	Defense	Gov't Spend	USSR	Inflation	Ideology
Constant	4.65**	4.24**	4.36**	4.35**	4.17**
	(0.73)	(1.22)	(0.91)	(0.94)	(1.38)
Subs Cov	-0.03**	-0.03*	-0.03**	-0.03**	-0.03*
	(0.001)	(0.01)	(0.01)	(0.001)	(0.01)
Media Exp	-0.53	-2.01*	0.41	-1.13	-0.85
	(0.54)	(0.91)	(0.68)	(0.70)	(1.04)
Med*Subs	0.005	0.02*	-0.01	0.01	0.01
	(0.005)	(0.01)	(0.07)	(0.01)	(0.01)
Rep	-0.05	0.13	0.15	0.18	0.18
	(0.11)	(0.17)	(0.13)	(0.14)	(0.20)
Dem	0.30	0.29	0.19	0.19	0.59
	(0.10)	(0.16)	(0.12)	(0.13)	(0.19)
Talk	-0.35**	-0.53**	-0.55**	-0.43**	-0.62**
	(0.09)	(0.13)	(0.10)	(0.11)	(0.16)
Education	-1.26**	-1.47**	-1.21**	-1.27**	-1.87**
	(0.13)	(0.20)	(0.16)	(0.17)	(0.24)
Race	0.56**	0.52*	0.34*	0.60**	0.29
	(0.15)	(0.23)	(0.17)	(0.19)	(0.26)
Female	0.28**	0.60**	0.34**	0.46**	0.62**
	(0.09)	(0.13)	(0.10)	(0.11)	(0.16)
Obs	1327	1467	1429	1437	1273
N	793	833	825	829	784
R-squared	0.20	0.10	0.15	0.12	0.13

Note: * indicates significance at the 5% level, ** indicates significance at the 1% level