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PROBABILISTIC POLLING AND VOTING IN THE 2008 PRESIDENTIAL ELECTION
EVIDENCE FROM THE AMERICAN LIFE PANEL

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Abstract This article reports new empirical evidence on *probabilistic polling*, which asks persons to state in percent-chance terms the likelihood that they will vote and for whom. Before the 2008 presidential election, seven waves of probabilistic questions were administered biweekly to participants in the American Life Panel (ALP). Actual voting behavior was reported after the election. We find that responses to the verbal and probabilistic questions are well-aligned ordinally. Moreover, the probabilistic responses predict voting behavior beyond what is possible using verbal responses alone. The probabilistic responses have more predictive power in early August, and the verbal responses have more power in late October. However, throughout the sample period, one can predict voting behavior better using both types of responses than either one alone. Studying the longitudinal pattern of responses, we segment respondents into those who are *consistently pro-Obama*, *consistently anti-Obama*, and *undecided/vacillators*. Membership in the consistently pro- or anti-Obama group is an almost perfect predictor of actual voting behavior, while the undecided/vacillators group has more nuanced voting behavior. We find that treating the ALP as a panel improves predictive power: current and previous polling responses together provide more predictive power than do current responses alone.

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Introduction

Pollsters have long asked persons to verbally express uncertainty about their voting intentions. Consider the *New York Times*/CBS News (NYT/CBS) presidential poll. In fall 2008, respondents were asked the following:[1]

V1. How likely is it that you will vote in the 2008 election for president this November—would you say you will definitely vote, probably vote, probably not vote, or definitely not vote in the election for president?
V2. If the 2008 presidential election were being held today and the candidates were Barack Obama, the Democrat, and John McCain, the Republican, would you vote for Barack Obama or John McCain?

Although V2 does not explicitly permit persons to express uncertainty, some volunteered that they were undecided. They were then asked:

V3. Well, as of today, do you lean more toward Barack Obama or more toward John McCain?

When persons responded to V2, they were asked this follow-up question to gauge the certitude of their preference:

V4. Is your mind made up, or is it still too early to say for sure?

Probabilistic polling is an alternative to verbal questioning that asks persons to state, in percent-chance terms, the likelihood that they will vote and for whom. The objective is to provide interpersonally comparable, quantitative measures of the uncertainty that persons perceive about their future voting behavior. Consider a person who responds to V1 that she will "probably vote," states "Obama" in response to V2, and declares that it is "too early to say for sure" when asked V4. This person clearly expresses some uncertainty, but the NYT/CBS questions permit her to give only a vague sense of her perceptions. In response to probabilistic polling questions, this person might state that she perceives a 75-percent chance of voting and that, conditional on voting, she sees a 60-percent chance of voting for Obama. These responses provide a precise report of her voting intentions. They imply that the respondent perceives an unconditional probability of 0.45 of voting for Obama.

To see the advantages of probabilistic polling, consider the efforts that pollsters make to classify respondents as *likely/unlikely* voters and as *decided/undecided* in their candidate preference. Some divide the electorate into two groups: those who are likely and unlikely to vote. They similarly segment

1. See http://graphics8.nytimes.com/packages/pdf/politics/20080918_POLL.pdf.

respondents into groups who support particular candidates and a residual group who remains undecided.

Efforts to classify potential voters are problematic, because there is no way to predict with certainty who will vote and for whom. Considering attempts to define likely voters, Mark Mellman put it this way in the September 8, 2004, issue of *The Hill*:

> "Likely" and "unlikely" are probability statements. A likely voter has, say, an 80 percent chance of voting. An unlikely voter has a 20 percent chance of showing up to the polls. Thus, out of every 100 likely voters, 20 will not show up, while 20 of every 100 unlikely voters will. Polling only likely voters skews the sample, systematically excluding a group that will show up in some meaningful numbers on Election Day.

When Mellman wrote that polling only likely voters "skews the sample," he recognized that persons deemed likely and unlikely to vote may differ in the votes that they will actually cast. This possibility makes surveys of likely voters controversial.[2]

It seems evident that pollsters should assign voting probabilities to members of the electorate, rather than classify them as likely/unlikely and decided/undecided. A central objective of polls is to predict election outcomes. Probabilistic polling provides self-reported voting probabilities. Pollsters may use the responses directly or combine them with other information to develop probabilistic predictions of voting.[3]

Although the potential advantages of probabilistic polling are transparent, practical experience has been scant. There has been a conventional wisdom that respondents would be unable or unwilling to respond informatively to questions asking for probabilistic predictions of voting behavior. This has inhibited conduct of research that might shed light on the matter.

We report new empirical evidence. Before the 2008 presidential election, probabilistic polling questions were administered biweekly to participants in the American Life Panel (ALP), the RAND longitudinal Internet survey. To familiarize respondents with probabilistic polling, respondents were given this introduction:[4]

2. The likely-voter model used by the Gallup organization drew attention in 2004 for possible skewing toward Republican voters (Traugott 2005) and was criticized in 2000 for exaggerating the volatility of voter preferences (Erikson, Panagopoulos, and Wlezien 2004).

3. Some polling organizations already make probabilistic predictions of voting, but they do not use self-reported voting probabilities as inputs. One is the NYT/CBS poll, whose documentation states: "Every registered voter is included in the likely voter model, and is assigned a probability of voting, which is used to calculate the likely voter results. The sum of these probabilities is the effective number of likely voters"(http://www.cbsnews.com/htdocs/CBSNews_polls/bushkerry100404.pdf).

4. This introduction paraphrases one used in the Survey of Economic Expectations (SEE), discussed in section 2. Responses provided by the respondents are not clustered around the percentages presented in this introduction.

> In this interview, we will ask you questions about the upcoming general election for president of the United States. The presidential election is scheduled for Tuesday, November 4, 2008. Many of the questions ask you to think about the percent chance that something will happen in the future. The percent chance can be thought of as the number of chances out of 100. You can use any number between 0 and 100. For example, numbers like 2 and 5 percent may be "almost no chance," 20 percent or so may mean "not much chance," a 45- or 55-percent chance may be a "pretty even chance," 80 percent or so may mean a "very good chance," and a 95- or 98-percent chance may be "almost certain."

They were then asked:

P1. What is the percent chance that you will vote in this year's presidential election?
P2. Barack Obama is the Democratic candidate, and John McCain is the Republican candidate. If you do vote in the presidential election, what do you think is the percent chance that you will vote for, Barack Obama (Democrat) ___ % John McCain (Republican)___ % Someone else___ %

Verbal questions similar to V1 through V3 were also administered; the versions of V2 and V3 permitted respondents to express a preference for candidates other than Obama and McCain.[5] In mid-November, respondents were asked whether they had voted and, if so, for whom.

We first summarize the large literature on measurement of probabilistic expectations in surveys and the few previous applications of probabilistic polling. We then describe and analyze the data collected from the ALP respondents.

Related Literature

SURVEY RESEARCH ELICITING PROBABILISTIC EXPECTATIONS

There long was a conventional wisdom among survey researchers that typical respondents will not or cannot respond informatively to percent-chance questions about future events. Hence, the standard practice was to measure uncertainty verbally. For example, the General Social Survey (GSS) has used this question to elicit perceptions about future job loss (Davis and Smith 1994):

Thinking about the next 12 months, how likely do you think it is that you will lose your job or be laid off: very likely, fairly likely, not too likely, or not at all likely?

5. The order of the names of the two major candidates was randomized when administering the verbal and probabilistic candidate preference questions. Before the Republican convention, P2 began with the words "Suppose that."

It is instructive to compare this question with V1. Whereas the GSS uses four phrases (very likely, fairly likely, not too likely, not at all likely) to express degrees of certitude, V1 uses another four phrases (definitely, probably, probably not, definitely not). Responses to the GSS and the NYT/CBS poll do not reveal how respondents interpret these phrases. When different respondents to the GSS state "fairly likely," they may not mean the same thing. When a person states "probably" in response to V1, it is not clear how she would have responded if the GSS phrases had been used.

The conventional wisdom began to break down in the 1990s, particularly among economists who perform survey research. One concern was that verbal questions yield only ordinal measures of beliefs. Another was that the responses may not be interpersonally comparable. These concerns led to research assessing the viability of probabilistic questioning, using a percent-chance format.

Researchers have gradually accumulated experience with probabilistic questions, using them to learn how persons perceive various aspects of their futures. Manski (2004) reviews the history in several disciplines, describes the emergence of the modern literature, summarizes applications, and discusses open issues. Delavande and Rohwedder (2008), Hurd (2009), and Delavande, Giné, and McKenzie (forthcoming) review specific aspects of recent research.

Among the major American platforms for methodological and substantive research, the Health and Retirement Study (HRS) has periodically elicited probabilistic expectations of retirement, bequests, and mortality from multiple cohorts of older Americans (Hurd and McGarry 1995, 2002; Hurd, Smith, and Zissimopoulos 2004). The Survey of Economic Expectations (SEE) asked repeated cross-sections to state the percent chance that they will lose their jobs, have health insurance, or be victims of crime in the year ahead, and also to give income expectations (Dominitz and Manski, 1997a, 1997b; Manski and Straub 2000). The National Longitudinal Survey of Youth 1997 has periodically queried youth about the chance that they will become a parent, be arrested, or complete schooling (Fischhoff, Parker, de Bruin, et al. 2000; Dominitz, Manski, and Fischhoff 2001; Lochner 2007). Probabilistic expectations of stock market returns have been elicited in SEE, HRS, and the monthly Reuters/Michigan Surveys of Consumers (Dominitz and Manski 2004, Dominitz and Manski 2007; Hurd 2009). We have learned from these and other surveys that most people have little difficulty, once the concept is introduced, using subjective probabilities to express the likelihood they place on future events relevant to their lives.

PREVIOUS PROBABILISTIC POLLING STUDIES

Scattered researchers have independently suggested probabilistic polling and conducted exploratory studies. The earliest work that we are aware of is by Meier (1980) and Meier and Campbell (1979), who used a seven-point scale

to elicit voting expectations. Maas, Steenbergen, and Saris (1990) analyzed probabilities of voting for particular parties by Dutch voters. Burden (1997) analyzed data collected in Ohio eliciting probabilities that persons would vote for particular candidates in state and federal elections. Hoek and Gendall (1993, 1997) elicited voting probabilities in elections in New Zealand. These isolated studies have not sufficed to evaluate the merits of probabilistic polling, but they are instructive in some respects. Manski (2002) discusses the work of Burden (1997) and Hoek and Gendall (1997).

Manski (1990, 2000) briefly proposed probabilistic polling, followed by a more lengthy appraisal in Manski (2002). The last article reported a pilot study in a Chicago suburb performed before the 2000 presidential election. The questions posed were analogous to P1 and P2. The findings were encouraging, but the sample was too small and idiosyncratic to permit firm conclusions.

The ALP Data

The ALP is a longitudinal survey of Americans aged 18 and older, begun by RAND in 2006.[6] Until October 2009, most participants were recruited from outgoing participants in the Reuters/Michigan Surveys of Consumers, who had previously been interviewed twice in that nationally representative survey. These persons were asked if they would be willing to participate in Internet surveys. The ALP recruited panelists from those who gave any response except "no, certainly not." Through August 2008, about 51 percent of these referrals agreed to be considered for the ALP, and about 58 percent of this group participated in at least the core household characteristics module of the ALP. Thus, about 30 percent (51 percent × 58 percent) of the potential recruits became participants. Once in the ALP, participants receive a biweekly request to respond to a new half-hour survey, and are paid about $20 per completed survey.

About 80 percent of the participants studied in this article were recruited in the above manner, the remaining 20 percent being a "snowball sample" whose names were suggested by current participants. About 90 percent of participants have their own Internet access. RAND provides a Web TV to the remaining 10 percent.

As is typical with Internet surveys, ALP respondents over-represent some demographic groups. In all, 1,814 participants responded to at least one preelection survey and to the post-election survey. Relative to the electorate, respondents are more often female (57 percent), non-Hispanic White (89 percent), middle-aged (41 percent with age 50–64), and college-educated (45 percent with 16 or more years of schooling).

6. The ALP is documented at https://mmicdata.rand.org/alp/index.php/Main_Page.

Whereas the demographic composition of the ALP differs from the electorate, the panel may more closely approximate the subpopulation who votes. Fully 90 percent of the respondents reported in the post-election survey that they had voted for president, while the national turnout was estimated to be 62 percent.[7] Of those who reported that they voted, 50 percent stated that they voted for Obama, 48 percent for McCain, and two percent for another candidate. This makes the voting composition of the sample a bit more Republican than the actual vote, which was 53 percent for Obama, 46 percent for McCain, and one percent for others.[8]

We think that the high turnout reported by ALP respondents stems mainly from the fact that the panel over-represents groups who vote at a higher rate than the electorate. However, a contributing reason may be overreporting of voting. Belli, Traugott, and Beckmann (2001) compared self-reports of voting on the American National Election Survey (ANES) with administrative data from voting records. They found that the self-reports of ANES respondents exceeded actual voting rates by 7.9 to 14.2 percent during 1964–90. We conjecture that ALP self-reports are more accurate than ANES ones, because ALP participants have a long-term attachment to the survey and because they were queried about their voting immediately after the election rather than several months later. Moreover, the methodological literature suggests that responses to Internet surveys may be more accurate due to the absence of an interviewer, with consequent reduction of social desirability bias (Bradburn and Sudman 1979; Tourangeau and Smith 1996).

Non-representativeness of the electorate is a shortcoming of the ALP, but the ability to interview panel members repeatedly is an advantage. Most traditional polls are repeated cross-sections, drawing new samples each time they go into the field. Hence, one cannot study the evolution of respondent voting intentions over time. Nor can one compare the voting intentions that persons state before an election with their actual voting behavior. The ALP enables all of this.[9]

Questions P1 and P2 were administered on seven pre-election waves of the ALP. Each wave began when panel members received an email asking them to access a web page to respond to a new survey. Participants could respond anytime until the next wave was fielded, about two weeks later. The pre-election questions appeared on these waves, with the opening date in parentheses: wave 38 (August 4), wave 40 (August 18), wave 42 (September 2), wave 44

7. See http://elections.gmu.edu/Turnout_2008G.html for this turnout estimate.

8. Sections 4 through 6 study several subsamples of the 1,814 participants described here. The compositions of these analytical samples are very similar to the overall sample. For example, section 5 studies 867 respondents who responded to all surveys. These were 54 percent female, 91 percent non-Hispanic white, 44 percent middle-aged, and 46 percent college-educated. Of this group, 92 percent reported voting for president, with 49 percent choosing Obama, 49 percent McCain, and two percent another candidate.

9. Other longitudinal polls include the ANES and the National Annenberg Election Survey.

(September 15), wave 47 (September 29), wave 49 (October 13), and wave 51 (October 27). Respondents reported their voting behavior in wave 52 (November 7).[10]

In each pre-election wave, administration of P1 and P2 was followed by a question asking respondents to predict who would win the election. This question was followed by extensions of V1 through V3, the versions of V2 and V3 permitting respondents to express a preference for candidates other than Obama and McCain.

A split-sample design would be advantageous for some research purposes, administering only the probabilistic questions to some respondents, only the verbal ones to others, and both sets of questions in differing orders to yet others. However, it was judged that such a design carries too high a price in diminished sample size in the ALP context. An important objective of this project was to study how well probabilistic and verbal responses combine to predict voting behavior (see section 6). This consideration informed the chosen design. Nevertheless, we think that a split-sample design would be beneficial if sufficient sample size were available.

Verbal Responses, Probabilistic Responses, and Voting Behavior

We begin by comparing the verbal and probabilistic responses with each other, and with subsequent voting behavior. We focus on wave 44, fielded in the middle of the sampling period. A total of 2,261 persons were participants in the ALP at the time of wave 44, and 1,591 of those completed the wave 44 survey, yielding an interview response rate of 0.704. Among the 1,591 interviewees, the item response rates to P1–P2 and V1–V3 were all over 0.99. Hence, noncooperation stemmed almost entirely from interview nonresponse, not item nonresponse.

The response patterns are very similar across waves in most respects. Tables A1–A3 in our online appendix report findings for all waves.

VOTING LIKELIHOOD

Table 1 tabulates the responses to questions V1 and P1 in wave 44. The table presents data for respondents who answered V1 and P1 in wave 44, and who reported their voting behavior after the election, in wave 52. These criteria were met by 1,474 respondents, so the cooperation rate for the present analysis is 1,474/2,261 = 0.652.

Most respondents (82 percent) state that they will definitely vote. Of the others, (10, 3, 5) percent state that they will (probably, probably not, definitely

10. Wave 51 ended after the election. We use only responses submitted before the election.

Table 1. Verbal and Probabilistic Likelihood of Voting in Wave 44

			Percent-Chance Response				
Verbal response	Sample size	Percent of sample	Mean	0.25 quantile	Median	0.75 quantile	Fraction who vote
Definitely	1,211	82	99	100	100	100	0.99
Probably	151	10	73	50	80	90	0.75
Probably not	39	3	23	10	20	40	0.23
Definitely not	73	5	3	0	0	0	0.05
Total sample	1,474	100	90	99	100	100	0.90

not) vote. Persons who state that they will (definitely, probably, probably not, definitely not) vote respectively report a (99, 73, 23, 3) mean percent chance of voting. The corresponding medians are (100, 80, 20, 0). Thus, the table shows a strong ordinal correspondence in the verbal and probabilistic likelihoods of voting.

Examination of the (0.25, 0.50, 0.75) quantiles of the distribution of response to the percent-chance question shows that the verbal phrases "probably" and "probably not" encompass much more varied quantitative perceptions of voting likelihood than the phrases "definitely" and "definitely not." The three quantiles of the response distribution are (100, 100, 100) for persons who state that they will definitely vote and (0, 0, 0) for those who state they will definitely not vote. The three quantiles are (50, 80, 90) for persons who state that they will probably vote and (10, 20, 40) for those who state that they will probably not vote. Thus, the phrases "definitely" and "definitely not" map well onto the extreme percentages 100 and 0, but "probably" and "probably not" summarize wide ranges of probabilistic beliefs.

The final column of table 1 gives the fraction of respondents who report after the election that they voted. Of those stating that they will (definitely, probably, probably not, definitely not) vote, the fractions who later report that they did vote are (0.99, 0.75, 0.23, 0.05). These voting rates are close to the average and median percent chances of voting that respondents stated a month and a half before the election. As we explore the data further, we repeatedly find that the probabilistic responses predict well the voting behavior of respondents.

CANDIDATE PREFERENCE

Table 2 tabulates the responses to questions V2 and P2 in wave 44. The table presents data for respondents who answered V2 and P2, and who reported their voting behavior after the election.

We have usable data for 1,461 respondents, so the cooperation rate for the analysis of this section is 1,461/2,261 = 0.646.[11] Of these persons, 44 percent stated that they would vote for Obama, 47 percent for McCain, and three percent for another candidate if the election were held today. Of the six percent who chose not to answer V2, (3, 2, 1) percent stated that they lean toward (Obama, McCain, someone else).

The table shows a strong ordinal correspondence in the verbal and probabilistic candidate preferences. Persons who stated that they would vote for (Obama, McCain, someone else) if the election were held today respectively reported a (92, 6, 7) mean and (100, 0, 0) median percent chance of voting for Obama, conditional on voting. Persons who stated that they lean toward (Oba-

11. Observations are usable when respondents report verbal and probabilistic candidate preference, and report whether they voted (and if so, for whom) after the election.

Table 2. Verbal and Probabilistic Candidate Preference in Wave 44

			Percent-chance of voting for Obama, conditional on voting				Voting behavior	
Verbal response	Sample size	Percent of sample	Mean	0.25 quantile	Median	0.75 quantile	Fraction voting	Fraction voting for Obama, conditional on voting
Obama	639	44	92	95	100	100	0.94	0.97
Lean to Obama	37	3	57	50	50	60	0.86	0.72
Lean to McCain	33	2	40	35	50	50	0.73	0.21
McCain	681	47	6	0	0	0	0.93	0.05
Someone else	50	3	7	0	0	2	0.52	0.19
Lean to someone else	21	1	16	0	0	40	0.24	0.40
Total sample	1,461	100	46	0	40	100	0.90	0.49

ma, McCain, someone else) respectively reported a (57, 40, 16) mean and (50, 50, 0) median percent chance of voting for Obama.

The penultimate column of table 2 gives the fraction of respondents who reported after the election that they had voted. Persons who stated a definite candidate preference voted more frequently than those who only stated that they leaned toward a candidate. Of the persons who stated in wave 44 that they would vote for (Obama, McCain, someone else) if the election were held today, the fractions that later reported voting are (0.94, 0.93, 0.52) percent. The corresponding fractions for those who only leaned toward a candidate are considerably lower, being (0.86, 0.73, 0.24). Observe that persons who preferred or leaned toward one of the two major-party candidates voted much more frequently than did those who preferred or leaned toward another candidate.

The final column gives the fraction of voting respondents who reported after the election that they had voted for Obama. Almost all those who stated a preference for a major-party candidate later reported voting for the preferred andidate. Those who stated only that they leaned toward a candidate tended to vote for this candidate, but significant minorities voted for another candidate.

Table 3 views candidate preferences from the perspective of probabilistic polling. The left panel segments respondents by their response to P2, focusing on the chance of voting for Obama, conditional on voting. For example, the row marked [70, 80) considers persons who state a 70- to 79-percent chance of voting for Obama, if they do vote. The right panel segments respondents by their unconditional stated likelihood of voting for Obama, given by the product of their responses to P1 and P2. Here, the row marked [70, 80) considers persons for whom the product of the responses to P1 and P2 lies in the interval [70, 80).

Comparing the first and last columns of each panel, we find a close correspondence between the voting probabilities expressed in mid-September and subsequent voting behavior. The correspondence at the extremes was already apparent in table 2; the persons who stated a 90 to 100 (0 to 10) percent chance of voting for Obama overlap strongly with those who stated they would vote for Obama (McCain) if the election were held today.

The value of probabilistic polling relative to verbal questioning manifests itself in the intermediate rows of table 3. Whereas verbal questioning only coarsely partitions "undecided" voters into those who lean toward one candidate or another, probabilistic polling quantifies the degree of certitude of the candidate preference. A person who states that she leans toward Obama might state a 50-, 60-, or 75-percent chance of voting for Obama. One who states that she leans toward McCain might state a 25-, 40-, or 50-percent chance of voting for Obama. Table 3 shows that voting behavior has a strong positive association with the stated percent chance of voting for Obama. There are occasional exceptions, but this should be expected given the small to moderate sizes of the group with intermediate values of the subjective probabilities.

Table 3. Probabilistic Responses in Wave 44

Voting by conditional likelihood of voting for Obama						Voting by unconditional likelihood of voting for Obama			
Percent chance of voting for Obama, if you do vote	Sample size	Percent of sample	Average stated likelihood of voting	Fraction who vote	Fraction who vote for Obama, conditional on voting	Percent chance of voting for Obama	Sample size	Percent of sample	Fraction who vote for Obama
[90, 100]	512	35	96	0.96	0.98	[90, 100]	470	32	0.97
[80, 90)	37	3	86	0.92	0.91	[80, 90)	37	3	0.97
[70, 80)	31	2	90	0.90	1.00	[70, 80)	34	2	0.91
[60, 70)	34	2	86	0.94	0.78	[60, 70)	30	2	0.77
[51, 60)	13	1	98	1.00	0.92	[51, 60)	20	1	0.85
50	74	5	78	0.77	0.53	50	43	3	0.56
(40, 50)	16	1	89	0.88	0.71	(40, 50)	29	2	0.66
(30, 40]	42	3	83	0.86	0.31	(30, 40]	35	2	0.34
(20, 30]	41	3	84	0.85	0.23	(20, 30]	57	4	0.23
(10, 20]	31	2	76	0.74	0.09	(10, 20]	37	3	0.14
[0, 10]	631	43	89	0.88	0.02	[0, 10]	670	46	0.02
Total sample	1,462	100	90	0.90	0.49	Total sample	1,462	100	0.45

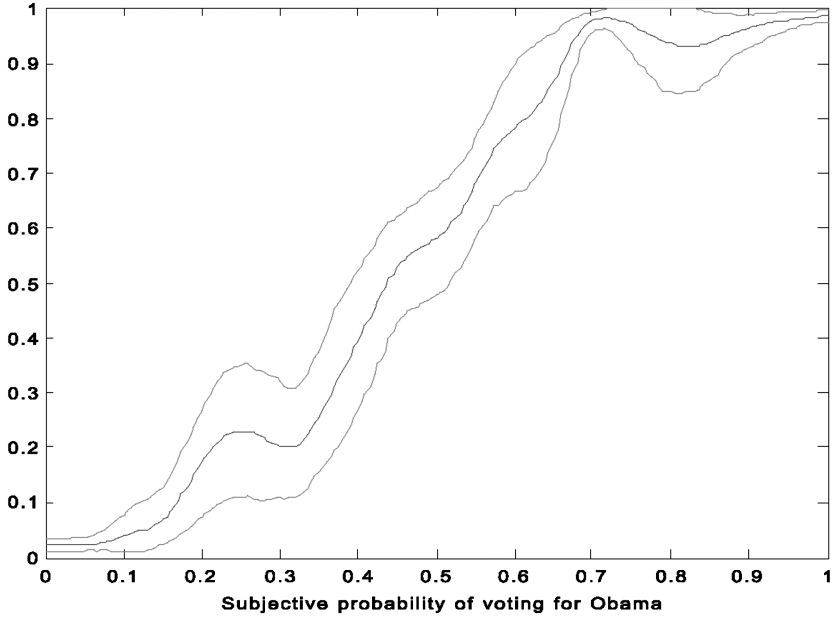

Figure 1. Probability of voting for Obama conditional on probabilistic preference for Obama in wave 44. The *x*-axis gives the response to question P2, divided by 100. The conditional probabilities are estimated by kernel regression using the Gaussian kernel with Silverman's rule-of-thumb bandwidth (1,170 observations). The inner curve gives the regression estimate. The outer curves give bootstrapped 95-percent confidence intervals (500 draws).

To provide further perspective, figure 1 plots a kernel nonparametric regression estimate of the relationship between responses to question P2 and subsequent candidate choice. The figure graphically displays the data summarized in the left panel of table 3. The *x*-axis, which ranges over the interval 0–1, gives a person's response to P2 divided by 100. The *y*-axis gives the estimated vote share for Obama. The estimated relationship is strongly increasing. The estimated vote share increases slowly for P2 responses below about 0.3, then roughly linearly for responses in the range 0.3–0.7, after which it stays close to one. These results show that the elicited subjective probabilities of voting are not only strong ordinal but also quantitative predictors of voting behavior.

LONGITUDINAL RESPONSE PATTERNS

The ALP data enable us to examine how the voting intentions of individual respondents evolve over time. With this in mind, we now focus on the 867

Table 4. Response Patterns across Surveys, Respondents with Complete Data

A. Probabilistic responses

Percent chance of voting for Obama, if you do vote	Number of respondents	Fraction who vote	Fraction voting for Obama, conditional on voting
	Consistently pro Obama		
All [90, 100]	248	0.98	1.00
All [80, 100], some [80, 89]	23	0.87	1.00
All [70, 100], some [70, 79]	24	1.00	1.00
All [60, 100], some [60, 69]	26	0.96	0.96
All [50, 100], some (50, 59]	41	0.93	0.89
	Undecided/vacillators		
All 50	1	0.00	NA
Some [51, 100] and [0, 49]	85	0.87	0.59
	Consistently anti Obama		
All [0, 50], some [41, 50)	56	0.70	0.03
All [0, 40], some [31, 40]	22	0.82	0.00
All [0, 30], some [21, 30]	18	0.89	0.00
All [0, 20], some [11, 20]	20	0.85	0.00
All [0, 10]	303	0.93	0.00
Total sample	867	0.92	0.49

B. Verbal responses

Candidate preference	Number of respondents	Fraction who vote	Fraction voting for Obama, conditional on voting
Consistently pro Obama	356	0.96	0.99
Vacillators	163	0.77	0.42
Consistently anti Obama	364	0.92	0.01
Total sample	883	0.91	0.49

panel members who participated in all seven pre-election waves, who always answered P2, and who reported their voting behavior after the election. A total of 2,112 persons were ALP members at the time of wave 38 and, hence, potentially able to participate in all relevant waves. Thus, the cooperation rate for the present analysis is 867/2,112 = 0.411.

Table 4A segments respondents into three groups, with further division into subgroups. The top group of 362 *consistently pro-Obama* persons states at

least a 50-percent chance of voting for Obama in all seven pre-election waves and sometimes states a higher likelihood. For example, a person is a member of the "all [80, 100], some [80, 89]" group if all of her responses are in the range [80, 100] and some are in the range [80, 89]. The bottom group of 419 *consistently anti-Obama* persons never report more than a 50-percent chance of voting for Obama and sometimes report less than 50 percent.

The middle group of 86 *undecided/vacillators* is neither consistently pro nor anti Obama before the election. We use the hybrid term "undecided/vacillators" because this group contains at least two types of persons. The word "undecided" describes persons who consistently state close to an even chance of voting for Obama, while "vacillators" describes ones who waver over time between high and low subjective probabilities of voting for Obama. The term "undecided" clearly fits one respondent whose seven responses to P2 were (50, 60, 40, 20, 70, 60, 60). The term "vacillator" fits another respondent whose responses were (0, 25, 50, 0, 100, 100, 100).

We find that membership in the consistently pro- or anti-Obama group is an almost perfect predictor of voting behavior. Of the consistently pro-Obama persons who vote, voting for Obama is unanimous among those who always state at least a 70-percent chance of doing so and is nearly unanimous among those who always state at least a 60-percent chance. Of the 41 respondents who sometimes state a 50- to 59-percent chance of voting for Obama, 38 persons vote, and 34 of these vote for Obama.

Symmetrically, persons who are consistently anti-Obama before the election essentially never vote for him. Of those who never state more than a 40-percent chance of voting for Obama, no one votes for him. Of the 56 respondents who sometimes state a 41- to 50-percent chance of voting for Obama, 39 vote and just one of them votes for Obama.

This leaves the undecided/vacillators. This group comprises only about 10 percent of the respondents studied in table 4A, but is potentially important because the pro- and anti-Obama groups are close in size. If the 2008 election had been held among the ALP respondents, the voting of the undecided/vacillator group would have determined its outcome (59 percent of the voters in the group voted for Obama). It is reasonable to conjecture that the party conventions, presidential debates, and other events of the election campaign affected the voting intentions and behavior of mainly this group.

Whereas table 4A studies respondents with complete probabilistic responses, table 4B reports parallel findings for the 883 respondents with complete verbal responses. Here, a person is *consistently pro-Obama* if he prefers or leans toward Obama in all waves, and is *consistently anti-Obama* if he always prefers or leans toward another candidate. *Vacillators* are neither consistently pro nor anti Obama. Again, membership in a consistent group

Table 5A. Predicting the Obama Vote with Wave 38 Data (standard errors in parentheses)

	Predictors	
	Current candidate preference	Current candidate preference, respondent attributes
Wave 38 verbal preference (response to V2/V3, Obama as default)		
Lean to Obama	0.055	0.058
	(0.089)	(0.090)
Lean to McCain	-0.388	-0.385
	(0.091)	(0.090)
McCain	-0.322	-0.325
	(0.089)	(0.090)
Someone else	-0.421	-0.426
	(0.126)	(0.124)
Lean to someone else	-0.354	-0.330
	(0.144)	(0.142)
Wave 38 probabilistic preference		
Probability of voting for Obama	0.672	0.660
	(0.093)	(0.094)
Probability of voting for someone else	0.263	0.276
	(0.159)	(0.157)
Respondent attributes		
Female		-0.010
		(0.014)
Non-Hispanic Black		0.050
		(0.023)
Hispanic		-0.048
		(0.082)
Other race		-0.096
		(0.060)
Age 35–49		-0.012
		(0.032)
Age 50–64		0.000
		(0.031)
Age 65+		0.016
		(0.032)
13–15 years of schooling		-0.004
		(0.023)
16+ years of schooling		0.026
		(0.023)
Constant	0.333	0.333
	(0.091)	(0.096)
Root mean square error	0.221	0.220

Table 5B. Predicting the Obama Vote with Wave 38 and 44 Data (standard errors in parentheses)

	Predictors		
	Current candidate preference	Current and past candidate preferences	Current and past candidate preferences, respondent attributes
Wave 44 verbal preference (response to V2/V3, Obama as default)			
Lean to Obama	-0.090	-0.102	-0.090
	(0.104)	(0.093)	(0.091)
Lean to McCain	-0.496	-0.428	-0.425
	(0.110)	(0.109)	(0.109)
McCain	-0.557	-0.437	-0.429
	(0.087)	(0.091)	(0.091)
Someone else	-0.344	-0.197	-0.183
	(0.188)	(0.183)	(0.181)
Lean to someone else	-0.368	-0.304	-0.312
	(0.258)	(0.193)	(0.190)
Wave 44 probabilistic preference			
Probability of voting for Obama	0.420	0.156	0.162
	(0.090)	(0.091)	(0.092)
Probability of voting for someone else	-0.024	-0.081	-0.086
	(0.192)	(0.209)	(0.208)
Wave 38 verbal preference			
Lean to Obama		0.099	0.097
		(0.076)	(0.077)
Lean to McCain		-0.152	-0.155
		(0.087)	(0.086)
McCain		-0.128	-0.134
		(0.085)	(0.084)
Someone else		-0.2227	-0.238
		(0.110)	(0.110)
Lean to someone else		-0.165	-0.158
		(0.137)	(0.135)
Wave 38 probabilistic preference			
Probability of voting for Obama		0.287	0.283
		(0.094)	(0.094)
Probability of voting for someone else		0.120	0.133
		(0.137)	(0.137)

Continued

Table 5B. Continued

	Predictors		
	Current candidate preference	Current and past candidate preferences	Current and past candidate preferences, respondent attributes
Respondent attributes			
Female			-0.008
			(0.012)
Non-Hispanic Black			0.020
			(0.015)
Hispanic			-0.072
			(0.058)
Other race			-0.051
			(0.047)
Age 35–49			-0.013
			(0.030)
Age 50–64			-0.001
			(0.028)
Age 65+			0.005
			(0.030)
13–15 years of schooling			-0.001
			(0.021)
16+ years of schooling			0.001
			(0.021)
Constant	0.581	0.573	0.579
	(0.087)	(0.101)	(0.105)
Root mean square error	0.205	0.191	0.191

is an almost perfect predictor of voting behavior, while vacillators split their vote.

Using Polling Responses and Respondent Attributes to Predict Voting Behavior

We have shown that responses to probabilistic polling questions have considerable power to predict the voting behavior of ALP respondents. Responses to verbal questions also have considerable predictive power. Verbal questioning has long been the norm. One might argue that traditional polling practices should continue unless the responses to probabilistic questions significantly enhance our ability to predict voting behavior, beyond what is possible with traditional polls.

Table 5C. Predicting the Obama Vote with Wave 38, 44, and 51 Data, (standard errors in parentheses)

	Predictors		
	Current candidate preference	Current and past candidate preferences	Current and past candidate preferences, respondent attributes
Wave 51 verbal preference			
Lean to Obama	0.016	0.026	0.029
	(0.140)	(0.158)	(0.161)
Lean to McCain	-0.834	-0.735	-0.732
	(0.051)	(0.080)	(0.081)
McCain	-0.673	-0.614	-0.613
	(0.101)	(0.112)	(0.112)
Someone else	-0.712	-0.657	-0.649
	(0.100)	(0.108)	(0.107)
Lean to someone else	-0.843	-0.771	-0.763
	(0.061)	(0.093)	(0.092)
Wave 51 probabilistic preference			
Probability of voting for Obama	0.318	0.236	0.238
	(0.103)	(0.112)	(0.112)
Probability of voting for someone else	0.203	0.110	0.101
	(0.099)	(0.103)	(0.102)
Wave 44 verbal preference			
Lean to Obama		-0.016	-0.013
		(0.040)	(0.041)
Lean to McCain		-0.126	-0.125
		(0.065)	(0.065)
McCain		-0.063	-0.060
		(0.069)	(0.070)
Someone else		0.108	0.112
		(0.105)	(0.105)
Lean to someone else		-0.089	-0.100
		(0.074)	(0.071)
Wave 44 probabilistic preference			
Probability of voting for Obama		-0.069	-0.069
		(0.056)	(0.057)
Probability of voting for someone else		-0.070	-0.068
		(0.141)	(0.140)
Wave 38 verbal preference			

Continued

Table 5C. Continued

	Predictors		
	Current candidate preference	Current and past candidate preferences	Current and past candidate preferences, respondent attributes
Lean to Obama		0.035	0.037
		(0.030)	(0.031)
Lean to McCain		-0.061	-0.061
		(0.064)	(0.064)
McCain		-0.046	-0.047
		(0.056)	(0.057)
Someone else		-0.142	-0.145
		(0.068)	(0.069)
Lean to someone else		0.068	0.070
		(0.101)	(0.102)
Wave 38 probabilistic preference			
Probability of voting for Obama		0.115	0.115
		(0.066)	(0.066)
Probability of voting for someone else		0.114	0.122
		(0.083)	(0.085)
Respondent attributes			
Female			0.002
			(0.009)
Non-Hispanic Black			0.031
			(0.016)
Hispanic			-0.008
			(0.019)
Other race			-0.030
			(0.022)
Age 35–49			0.003
			(0.023)
Age 50–64			0.003
			(0.020)
Age 65+			0.011
			(0.020)
13–15 years of schooling			-0.002
			(0.013)
16+ years of schooling			0.001
			(0.014)
Constant	0.673	0.719	0.710
	(0.103)	(0.094)	(0.096)
Root mean square error	0.136	0.131	0.130

To address the question of predictive power, table 5 reports various best linear predictors (BLPs) of voting for Obama among the respondents who vote. Each BLP is estimated by least squares, with robust standard errors presented beneath the estimates. The bottom row of the table gives the root mean square error (RMSE) of the predictions made with the estimated predictor function.[12] We also estimated binary logit models. The pattern of findings is similar, so we do not present them here.

In principle, we would like to perform a nonparametric analysis, allowing the verbal and probabilistic responses to interact flexibly with one another and with respondent attributes. However, such an analysis would be complex to interpret. We will, however, briefly discuss kernel nonparametric regression estimates of the type shown in figure 1.

Subtables A, B, and C respectively use as predictors the data obtained in wave 38 alone, waves 38 and 44, and waves 38, 44, and 51. Thus, Table 5B predicts voting behavior using data available in early August. Table 5B uses data available in early August and mid-September. Table 5C uses data available in early August, mid-September, and late October. To enhance comparability of findings, all estimates are computed using a common sample of 1,020 respondents with complete data in waves 38, 44, and 51. Recall that 2,112 persons were ALP members at the time of wave 38 and, hence, potentially able to participate in all relevant waves. Thus, the cooperation rate for the present analysis is 1,020/2,112 = 0.483.[13]

The left panel of each subtable treats the ALP as a repeated cross-sectional survey, as in section 4. This panel uses as predictors only the verbal and probabilistic responses obtained in the current wave. The middle and right panels of tables 5B and 5C treat the ALP as a panel, using the responses obtained in the current and earlier waves. The right panel of each subtable adds respondent attributes as predictors of voting behavior. Examination of the table reveals multiple findings, discussed below.

12. The RMSE is defined as follows. Suppose that a sample contains J respondents. Let $y_j = 1$ if person j votes for Obama and $y_j = 0$ otherwise. Let $p(x_j)$ be a real function predicting the person's vote, using polling-response and attribute data contained in the covariates x_j. The mean square error of the predictor is the group average of the squared prediction errors $[y_j - p(x_j)]^2$. The RMSE is its square root.

13. We could produce many variants of table 5, but we choose not to for reasons of space and ease of exposition. We could produce tables that use all seven waves of data, but they would be more cumbersome to present and would only add marginal information. Instead of taking the outcome to be voting for Obama, we could take it to be a trinomial variable indicating whether a person votes for Obama, McCain, or someone else. We do not use this more complex outcome because a negligible fraction of the respondents vote for someone else. We could predict voting for Obama among all ALP respondents, including those who do not vote. Predicting voting among all respondents would be more cumbersome, because we would need to include as predictor variables the verbal and probabilistic responses on likelihood of voting. We choose not to do this because the great majority of respondents vote, making turnout a minor issue in the ALP. Thus, we think that table 5 suffices to show the main results of interest.

PREDICTIVE POWER OF PROBABILISTIC POLLING

The responses to the probabilistic questions clearly enhance one's ability to predict voting behavior, beyond what is possible using verbal responses alone. In every prediction scenario, the predicted probability of voting for Obama increases substantially with the respondent's probabilistic preference for Obama given in response to P2. Moreover, the parameter estimates are statistically precise. The probabilistic responses have predictive power even though the responses to the verbal questions V2 and V3 are also used as predictors throughout. Addition of respondent attributes as predictors does not diminish their predictive power at all.

The RMSE measures the average accuracy of the predictions, with lower values indicating higher levels of predictive power. For concreteness, consider the predictions made using the ALP as a repeated cross-section. The RMSEs in waves (38, 44, 51) are (0.221, 0.205, 0.136), respectively. Suppose that one uses only the verbal responses as predictors, rather than the verbal and probabilistic responses together. Then the corresponding RMSEs for the three waves are (0.240, 0.213, 0.140). Thus, using both responses as predictors significantly reduces prediction errors.

Observe that predictive power increased moderately from early August to mid-September and then dramatically by late October. The qualitative finding of increased predictive power as the election nears is not surprising, but it is useful to quantify the magnitude of the change through the RMSE.

PREDICTIVE POWER OF VERBAL POLLING

The responses to the verbal questions have their own predictive power, beyond what one achieves using the probabilistic responses alone. This finding holds across scenarios, and the estimates are usually statistically precise. Continuing the comparison of RMSEs when the ALP is used as a repeated cross-section, if one uses only the probabilistic responses as linear predictors, the RMSEs for the three waves are (0.233, 0.223, 0.165). Thus, neither the verbal nor the probabilistic responses are sufficient statistics for one another. Both contribute when performing linear prediction of voting behavior.

It is a necessary caveat to state that the verbal responses contribute to *linear* prediction. Figure 1 showed that the association between responses to question P2 and voting choices is nonlinear, having a small positive slope for low response values (0−0.3), a large positive slope in the mid-range (0.3− 0.7), and essentially zero slope for response values above 0.7. Using the probabilistic responses as linear predictors does not permit this nonlinearity to express itself and, hence, undervalues the predictive power of the probabilistic responses.

Suppose that one uses only the probabilistic responses as predictors and computes kernel nonparametric regression estimates. The RMSEs for the three waves turn out to be 0.223, 0.215, and 0.157. These results improve those obtained using the probabilistic responses as linear predictors.

CHOOSING BETWEEN PROBABILISTIC AND VERBAL POLLING

It is revealing to compare the RMSEs obtained using the probabilistic responses alone with those obtained using the verbal responses alone. Suppose that one were required to choose between the two types of question. We find that the probabilistic responses yield more accurate predictions in wave 38 (RMSE 0.223 versus 0.240), and the verbal responses in wave 51 (RMSE 0.140 versus 0.157). The two predictors are essentially equally accurate in the intermediate wave 44 (RMSEs 0.213 and 0.215).

These results indicate that the relative informativeness of probabilistic polling and verbal questioning changed with time. We did not anticipate this pattern, but it seems reasonable ex post. The strength of probabilistic polling is that it enables respondents to fully express uncertainty about their voting intentions. Respondent uncertainty was greatest early in the campaign and lessened as the election neared.[14]

PREDICTIVE POWER OF PANEL DATA

We find that treating the ALP as a panel rather than as a repeated cross-section has predictive power. Tables 5B and 5C show that using a person's current and previous polling responses to predict voting behavior enables more accurate predictions than using the current responses alone. Whereas the RMSEs in waves 44 and 51 using only current-wave polling responses are 0.205 and 0.136, they decrease to 0.191 and 0.131 when current and previous-wave responses are used.

PREDICTIVE POWER OF RESPONDENT ATTRIBUTES

Respondent attributes add essentially no predictive power beyond that in the polling responses. There is considerable variation in voting behavior by gender, age, and schooling when these attributes are used as predictors without regard to polling responses. However, table 5 shows that a person's polling

14. This is perhaps most evident in online appendix table A3, which shows that a larger fraction of respondents report extreme probabilities in wave 51, just prior to the election, than in earlier waves. Further evidence on the temporal pattern appears in table 5. Focus on the left panel, which is most straightforward to interpret. The coefficient on "Probability of Voting for Obama" weakens over time, from 0.647 in wave 38 to 0.454 in wave 44 to 0.351 in wave 51. The coefficients on a verbal preference for McCain correspondingly strengthen over time.

responses are a sufficient statistic for his or her attributes when computing BLPs. The parameter estimates for the respondent attributes are close to zero. Using the attributes as predictors leaves the RMSEs of prediction essentially unchanged, reducing them by at most 0.001 each wave.

Again, a caveat is that this conclusion applies to linear prediction. Personal attributes may have predictive power when interacted with the polling responses rather than used additively as in table 5.

Conclusion

This article contributes to the design and analysis of election polls. We have performed the first large-scale application of probabilistic polling to a presidential election. Our comparison of the verbal and probabilistic responses shows the viability and usefulness of probabilistic polling in Internet polling settings such as the ALP. We have found that probabilistic and verbal responses both contribute to prediction of voting behavior.

The main open issue concerns implementation of probabilistic polling in surveys that use other modes of administration to contact more representative samples of the electorate. One may reasonably ask whether the general electorate, contacted by an interviewer, will be as comfortable with probabilistic polling as the ALP respondents. We cannot answer this question with certainty, but the HRS and SEE provide relevant evidence. These surveys have successfully administered many probabilistic expectations questions to broad populations in telephone and face-to-face surveys. Probabilistic polling questions are simple to administer and understand, indeed more so than many of the questions asked in the HRS and SEE.

Another issue is how best to configure probabilistic and verbal questions, to maximize predictive power for voting behavior. Our results indicate that it is better to administer both types of question than either in isolation, but this lengthens the questionnaire relative to traditional practice. If one must choose between them, our findings suggest that it is better to ask probabilistic questions early on, when voter uncertainty is highest, and to ask verbal questions as the election nears. When one administers both types of question, the ordering and spacing of questions may affect data quality. Research using large split-sample designs would help determine best practice.

Supplementary Data

Supplementary data are available online at http://pubopq.oxfordjournals.org/.

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