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"Wisdom of crowds"? A decentralised election forecasting model that uses citizens' local expectations

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ABSTRACT

Many studies report the "wonders of aggregation" and that groups (often) yield better decisions than individuals. Can this "wisdom of crowds"-effect be used to forecast elections? Forecasting models in first-past-the-post systems need to translate vote shares into seat shares by some formula; however, the seat–vote ratio alters from election to election. To circumvent this problem, this paper proposes citizen forecasting, which aggregates citizens' local expectations to directly forecast constituencies. Using data from the 2010 British Election Study, this paper finds (1) that groups are better forecasters than individuals, (2) that citizen forecasting correctly predicts a hung parliament, and (3) that marginality and group size are important predictors for "getting it right".

1. Introduction

In 2005, Labour won a comfortable 55 percent majority of the seats with just 35 percent of the votes. Five years later, the Conservatives received 36 percent of the votes but only 47 percent of the seats. Being alone short of an absolute majority, the Conservatives formed a coalition government with the Liberal Democrats. As a result of the coalition bargaining, the British public saw the Liberal Democrats break their campaign promise not to raise university tuition fees and a referendum on changing the electoral system to Alternative Vote, among other things. Had the Conservatives' votes in 2010 translated into seats as they did for Labour in 2005, the political consequences would have been much different.

The 2010 election illustrates that in first-past-the-post parliamentary elections seat shares—not vote shares—matter politically. Therefore, the most interesting election forecasting models focus on seat shares. However, forecasting seat shares is difficult. Past forecasting models have usually proceeded in two steps (e.g., Bélanger et al., 2005): in the first step, the models forecasted vote shares; in the second step, because votes do not translate directly into seats, they converted vote shares into seat shares by some formula (Tufte, 1973). Yet these two steps yield two potential error sources—the estimate of the vote share and the estimate of the seat share. One problem, for instance, is that the seat–vote ratio alters from election to election as illustrated above.

This paper proposes to circumvent these problems by directly forecasting seats using citizens' local expectations about the election outcome. This decentralised forecasting approach builds on the literature of "citizens as forecasters" (Lewis-Beck and Skalaban, 1989; Lewis-Beck and Tien, 1999; Lewis-Beck and Stegmaier, 2011) and is based on extensions of Condorcet's jury theorem. This theorem states that if group members have a greater than 50 percent chance of making the correct decision, the probability of a correct majority vote will increase rapidly towards unity as the group size increases to infinity (Condorcet, 1785, 1994; Miller, 1986). This "wisdom of crowds"-effect is the driving force behind the success of citizen forecasting.

The present research contributes to the forecasting literature by presenting a new model of citizen forecasting. Its main findings are (1) that groups are better forecasters than individuals at the constituency level, and (2) that

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groups can accurately forecast parties' local vote share and their national seat shares.

This paper proceeds as follows. The first section places the present research in the forecasting literature. The second section reviews in greater detail the theory behind "wisdom of crowds". The third section describes several studies—using the 2010 pre-election internet survey of the British Election Study—that explore whether citizens' local expectations about election outcomes can be used in forecasting models. Are groups better forecasters than individuals? Can groups also forecast vote shares? How can we explain that groups can forecast? The final section summarises the results and proposes how future studies could replicate citizen forecasting models.

2. A typology of election forecasting models

There are many election forecasting models (Campbell and Garand, 2000; Lewis-Beck, 2005). The forecasting models mainly differ in what they try to forecast, what predictors they use to forecast, and who does the forecasting. With regard to the forecasting target, some models forecast vote intentions using monthly poll data (Sanders, 1991, 2005; Whiteley, 1979), some forecast vote and seat shares (Mughan, 1987; Bélanger et al., 2005; Whiteley, 2005, 2008; Whiteley et al., 2011), whereas others forecast whether incumbents will be re-elected (Borisyuk et al., 2005).

There are also variations in the predictors used, though usually the models include one or more of the following three types: lagged values of the dependent variable, economic variables and political variables. For example, Norpoth (2004) forecasts the Conservative vote shares with lagged values only, whereas Bélanger et al. (2005) use inflation rate, government popularity, and terms in office to forecast vote and seat shares of the incumbent party.

Another type of model relies on citizens' expectations of the election outcome (Lewis-Beck and Skalaban, 1989; Lewis-Beck and Tien, 1999; Lewis-Beck and Stegmaier, 2011). Most individual British voters correctly forecast the winner of the general election (Lewis-Beck and Stegmaier, 2011). Further, voters seem to be able to forecast the national vote share of the winning party. The present research extends this line of research to the constituency level. The present research aggregates citizens' local expectations about the election outcome in each constituency. This aggregation yields a very accurate forecast because of the "wisdom of crowds"-effect.

3. "Wisdom of crowds" and forecasting election outcomes

The "wisdom of crowds" refers to the phenomenon that aggregated judgements are (often) more precise than that of the smartest person in the group (Hogarth, 1978; Hastie and Kameda, 2005; Larrick and Soll, 2006). Numerous studies in different areas report this effect (for an overview see Surowiecki 2004). Galton (1907), for example, reports that on an exhibition, the average of all estimates of an ox's weight was much more precise than any individual estimate.

Recent research on public opinion mirrors these findings. Page and Shapiro (1992) maintain that although many individuals seem to have non-attitudes (Converse, 1964), public opinion in aggregate responds to political events as one would expect. The reason for this effect is that a response is the sum of the true value and an error term. By summing over several responses these errors are likely to cancel each other out and the true opinions emerge clearly. There are, however, those who expressed suspicion of the "miracle of aggregation" (Converse, 1990; Surowiecki 2004).

Critics have suggested that the group may cloud the judgement of individuals. Janis (1982) and 't Hart (1994) both speculate about the danger of "groupthink" for those making judgements, and Solomon Asch's experiments about social conformity show the negative consequences groups may have on an individual's judgements (Asch, 1955). Moreover, models of social learning have sometimes identified the negative consequences of "herd behaviour" (Chamley, 2004). People behave as a herd if its members first observe the actions of other members and then behave in the same way dismissing any relevant personal information they might have. Models of "herd behaviour" highlight the importance of sequence—if the first person makes the wrong decision, they lead the whole group astray.

Condorcet's jury theorem and its extensions highlight the conditions under which groups outperform individuals. Condorcet's jury theorem implies that if the probability that a group member votes for the "correct" alternative is greater than 0.5, the probability of a correct majority vote will increase rapidly towards unity as the group size increases to infinity (Condorcet, 1785, 1994; Miller, 1986). By the same token, if the probability that a group member votes for the "incorrect" alternative is smaller than 0.5, the probability of an incorrect majority vote will decrease rapidly towards zero as the group size increases to infinity.

Condorcet derived this jury theorem under specific assumptions—same probability of being correct for each member, independence of members, and a binary decision; however, recent efforts have generalised it. A jury theorem holds even if not every member has the same probability of choosing the correct outcome as long as the mean probability of being correct is greater than 50 percent (Grofman et al., 1983; Boland, 1989). The same authors also show that a jury theorem still holds even under specific forms of correlated votes between members (see also Ladha, 1992; Estlund, 1994). Finally, List and Goodin (2001) generalise Condorcet's jury theorem to more than two alternatives. The theorem, accordingly, seems applicable to the present case, where voters may talk with each other or share the same information, have different probabilities of making the correct forecast and where more than two parties compete.

Surowiecki (2004) claims that two other conditions increase the likelihood of "wisdom of crowds"—diversity and decentralisation (together with aggregation). *Diversity* refers to information and not to socio-demographics (Surowiecki 2004). It is important that members of a group have different pieces of information so that combining their responses enriches the prediction. *Decentralisation* highlights the value of tacit knowledge (von Hayek, 1945): people who live in a constituency have local knowledge they can bring to the problem of predicting which party would win their constituency.[1] Meehl (1957) makes a similar point with his "broken leg analogy". One may have a plausible statistical model to predict whether professors watch a movie in the cinema based on two variables—his or her degree of extroversion and area of specialisation. This model may be on average right. But the model lacks common sense. The model may predict that a particular professor goes to the cinema, though he or she has a broken leg. The model lacks a "broken leg"-variable. Similarly, centralised election forecasting models may miss variables that are important for forecasting particular constituencies. Statistical models cannot incorporate all relevant information because they lack the degrees of freedom to do so. In contrast, citizens have the ability to incorporate unforeseen events in their decision making.

Diversity and decentralisation match the situation in forecasting elections. Firstly, a random sample of people within a constituency ensures a diverse selection of interviewed people. Secondly, letting citizens collectively forecast the winner in their constituency decentralises forecasting.

4. The present research

The present research has three goals. The first goal is to explore to what extent groups perform better than individuals in forecasting constituency election outcomes. People were asked to predict the winner in their constituency. Did people's individual expectations perform better than their aggregated expectations in predicting election outcomes?

The second goal is to forecast the national seat share. In each constituency, aggregating people's responses yields a prediction. These predictions are then aggregated across constituencies to a seats forecast and compared to the actual seat shares. How well does the model predict the election outcome? Can it also predict vote shares?

The third goal is to explain why groups get predictions right or wrong. I estimate the impact of "task difficulty" (e.g., marginality) and "group characteristics" on the probability to make a correct prediction (e.g., does group size increase accuracy?).

4.1. *Are groups better than individuals in forecasting elections?*

Who is better at forecasting: individuals or groups? This subsection compares the percentage of correct constituency forecasts between individuals and groups. This subsection first describes the data-set used to answer this and other research questions. It then explains the coding of individual responses and how these responses are aggregated in each constituency to yield group forecasts. I apply two different aggregation procedures—plurality voting and range voting (Smith, 2000) and demonstrate that the findings are independent of the aggregation procedure used. The subsection concludes by finding that indeed groups are better in forecasting than individuals.

The present research uses data from the 2010 British Election Study (BES) pre-election internet survey, which interviewed people in England, Wales and Scotland.[2] This data-set has three important advantages that make it particularly useful to answer the research questions—its timing, size, and content.

Forecasts are more impressive the earlier they are made. It seems relatively easy to predict the election outcome one day before the election. In contrast, forecasting the election before the campaign has started seems more difficult. The BES pre-election internet survey was finished one month before the general election on 6 May. The survey was in the field from 29 March until 7 April. More than 50 percent of the respondents completed the questionnaire by 1 April. Therefore, this survey allows to study whether citizens can forecast election results more than 4 weeks before the election takes place.

Besides the timing, its sheer size makes the BES pre-election internet survey ideal to study expectations and to forecast elections. The pre-election survey consists of 16,816 respondents and includes respondents in all 632 mainland constituencies. In principle the BES includes data on every single constituency outside Northern Ireland. However, in practice the size and scope of the survey is smaller for two reasons. First, only 13,334 gave a clear prediction who would win in their constituency. The remaining 3389 cases consist of three main groups: 1675 respondents were tied between two parties, 858 didn't respond, and 410 said no party had a chance of winning. Second, the present study only looks at the 627 constituencies won by the "main" five parties—Conservatives, Labour, Liberal Democrats, Plaid Cymru and the Scottish National Party. Nevertheless, these reductions still leave 21 valid responses ($SD = 6.5$) per constituency on average to provide group forecasts. Fig. 1 displays the histogram of responses at the constituency level. A minimum of just 4 respondents answered in Blaenau Gwent; and a maximum of 51 persons answered in the Isle of Wight.

Finally, and most importantly, the BES asked respondents to assess the chances of winning for each party—Labour, Conservatives, Liberal Democrats, Plaid Cymru, the Scottish National Party, and "other parties"—in turn. The question reads "On a scale that runs from 0 to 10, where 0 means very unlikely and 10 means very likely, how likely is it that [the name of the party] will win the election in your local constituency?" I label the responses to these questions raw expectation scores. Those that did not answer the question or were not asked the question for a specific party were coded at zero to retain them in the analysis.

The raw expectation scores form the material for the individual and group predictions. At the individual level, I simply code the party with the highest raw expectation score as the party the respondent thinks would win. At the aggregate level, however, I can choose among many voting procedures that translate individual expectations into group forecasts (for a discussion of different voting procedures see

[1] Bookmakers sometimes ask local experts to help them calculate profitable odds for by-elections and election (John Bartle, personal communication).

[2] The data-set can be downloaded from www.bes2009-10.org.

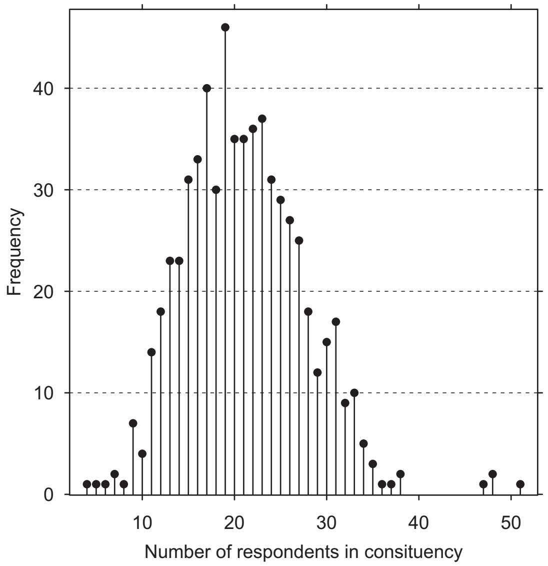

Fig. 1. BES 2010 pre-election internet survey: number of responses per constituency.

Mueller (1989)). To show that the results are independent of the aggregation procedure, I aggregate expectations using two very different voting procedures—plurality voting and range voting. These procedures differ in the amount of information they input. Plurality voting uses a minimum of information, whereas range voting uses all available information.

Plurality voting is perhaps the simplest aggregation method. It just looks at the percent of people who thought that the party would win (the *group forecast score*). The party with the highest group forecast score is predicted to win the constituency. Although plurality voting is widely used as a standard voting procedure, it discards a lot of available information. For instance, plurality voting only looks at the "first ranked party" and omits information about which party came second or third in the respondent's forecast. Similarly, plurality voting discards how certain the respondent was in making his forecast. A person who is 40 percent certain that party *A* would win counts the same as a person who is 80 percent certain that party *A* would win. Although the idea that all votes are equal is an attractive or even necessary feature of voting procedures, it may make sense to weight each response when aggregating expectations. Although past research points out that people are under-/overconfident, the same studies nevertheless show that the more confident people are, the more likely they are to give correct responses (Koriat et al., 1980; Fischhoff and MacGregor, 1982). An aggregation procedure that includes people's confidence should be more accurate than an aggregation model that discards this information. Therefore, I also aggregate expectations using the range voting procedure (Smith, 2000).

The range voting procedures uses standardised expectation scores. The standardisation translates the raw expectation scores into probability statements ranging from 0 to 100 percent. To standardise each individual response, I divide it by the sum of raw expectation scores for all parties. This transformation is useful when aggregating responses with the range voting procedure to compute the group forecast. The range voting procedure simply sums the standardised expectation score for each party across constituents in a constituency. It predicts the party with the highest sum to win the constituency.[3]

Consider the following example with three individuals i_{1-3} and two parties *A* and *B*. Each individual has raw expectations scores ranging from 0 to 10 about how likely it is that each party would win: i_1: $\{A = 10, B = 9\}$, i_1: {10,9}, and i_3: {1,9}. To translate these raw expectations into probability statements, the party's raw score is divided by the sum of all raw scores the individual assigned. The total raw score for each individual are as follows: $i_1 = i_2$: $10 + 9 = 19$ and i_3: $1 + 9 = 10$. Therefore, the respective standardised expectations are i_1:$\{A = 10/19 = 0.55,\ B = 9/19 = 0.45\}$, i_2:{0.55, 0.45} and i_3:{0.10, 0.90}. For instance, i_3 is 90 percent certain that party *B* would win. In this example, two people—i_1 and i_2—predict party *A* to win and only one individual—i_3—predicts party *B* to win. But the summed score for party A is $0.55 + 0.55 + 0.10 = 1.20$; the summed score for party *B* is $0.45 + 0.45 + 0.90 = 1.80$. Therefore, the plurality predicts party *A* to win, whereas the range voting procedure predicts party *B* to win—certainty trumps plurality. Again, one may feel uncomfortable with the idea that votes count unequally. When applied to aggregating expectations, however, it seems to make sense to incorporate as much information as possible.

Having described the data-set, the coding of the main variable, and the aggregation procedures, how do individuals compare with groups in forecasting elections? At the individual level, Table 1 shows that about 55 percent of respondents correctly predicted the winner in their constituency while about 25 percent got it wrong. In other words, 55 percent of respondents predicted the party to win that actually won the constituency, whereas 25 percent predicted one of the losing parties to win the constituency. The remaining 20 percent of respondents provided no clear answer to the expectation questions. In other words, by randomly choosing a person to predict the outcome in his or her constituency, we should get it on average 55 percent of the time right. If we only look at those that gave a valid response, the share of correct forecasters rises to 70 percent. Therefore, the condition of Condorcet's jury-theorem—a higher than 0.5 chance of being right—is met.

At the group level, Table 1 supports the claim that groups are better forecasters than individuals in the 2010 election. Groups predict 86 percent of constituencies correctly, whereas only 55 percent of individuals get it right. Aggregation increases the chance of a correct forecast compared with individual responses by 30 percent. Looking only at those individuals that made a prediction, the group forecast

[3] The following states the procedure in an algorithmic form: 1. For each individual *i*, sum all raw expectation scores for each party. Then divide each raw expectation score by that sum. This procedure yields standardised expectations for each party ranging from 0 percent chance of winning to 100 percent chance of winning (Blais et al., 2008). 2. In constituency *k*, sum the individual standardised expectation scores for each party *j* across individuals. Predict the party with the highest score to win the constituency.

Table 1
Performance of individual and aggregated predictions of which party will win in the constituency.

	Individual level		Constituency level			
			Plurality voting		Range voting	
	N	in %	N	in %	N	in %
Missing/no clear answer	3389	20.2	11	1.8	–	–
Incorrect	4114	24.6	79	12.6	88	14.0
Correct	9220	55.1	537	85.7	539	86.0
Total	16,723	100.0	627	100.0	627	100.0

Note: Results are based on the pre-election internet survey of the 2010 British Election Study. Results are only computed for the 627 constituencies that were won by one of the 'main' five parties—Conservatives, Labour, Liberal Democrats, Plaid Cymru and the Scottish National Party. The individual level results are based on responses to the question "On a scale that runs from 0 to 10, where 0 means very unlikely and 10 means very likely, how likely is it that [the name of the party] will win the election in your local constituency?" for each party. Those that did not answer the question or were not asked the question for a party received a value of zero. The party with the highest value is predicted to win the constituency. At the constituency level, the plurality voting procedure counts the number of people who expect that a party will win. It predicts the party with the highest number to win. The range voting procedure sums the standardised expectation responses for each party in each constituency. The party with the highest sum of standardised expectation score is predicted to win.

still improves the chances to get it right by 15 percentage points. The finding that groups are better forecasters than individuals is independent of the aggregation method used. Both plurality voting and range voting correctly predict 86 percent of the outcomes in the constituencies. Therefore, contrary to what was expected above, plurality voting is just as accurate as range voting. The only difference between the two using the 2010 data is that in plurality voting 11 constituencies are tied, whereas range voting yields a clear prediction in each constituency. Deciding the tied constituencies in plurality voting with the random flip of a coin increases the percent of correct predictions from 86 to 87 percent (no table shown). Therefore, the only advantage that range voting has over plurality voting is that it yields clear predictions after the first step. Plurality voting needs an additional step to decide tied races. When deciding these tied races by chance only, plurality voting is even slightly more accurate than range voting.

To visualise the performance of group forecasts across the country, Fig. 2 displays a coloured constituency map. Constituencies are equal size to show small seats in urban areas more clearly. The left panel of Fig. 2 shows the forecasting performance, whereas the right panel of Fig. 2 shows the British census regions to ease comparisons. Fig. 2 displays the result for the range voting procedure but the results for the plurality voting procedure look identical. In the left panel, grey constituencies indicate correct forecasts; black constituencies indicate incorrect forecasts or those 5 constituencies where a forecast was impossible. Fig. 2 seems to indicate a regional pattern. In the 2010 election, groups seem to perform worse in the South West, the West Midlands, and the North West than in the rest of the country. In contrast to that, London and the South East show large areas of grey constituencies with only few black dots. Therefore, nearly all groups in these regions made correct forecasts. As the final section will argue in more detail below, the two main reasons why groups get it right are group size and the winning margin. Because the constituencies in the South West, the West Midlands, and the North West had smaller groups and closer elections, they were more likely to get it wrong than other constituencies.

To sum up, groups are on average better forecasters than individuals. This is a robust finding independent of whether

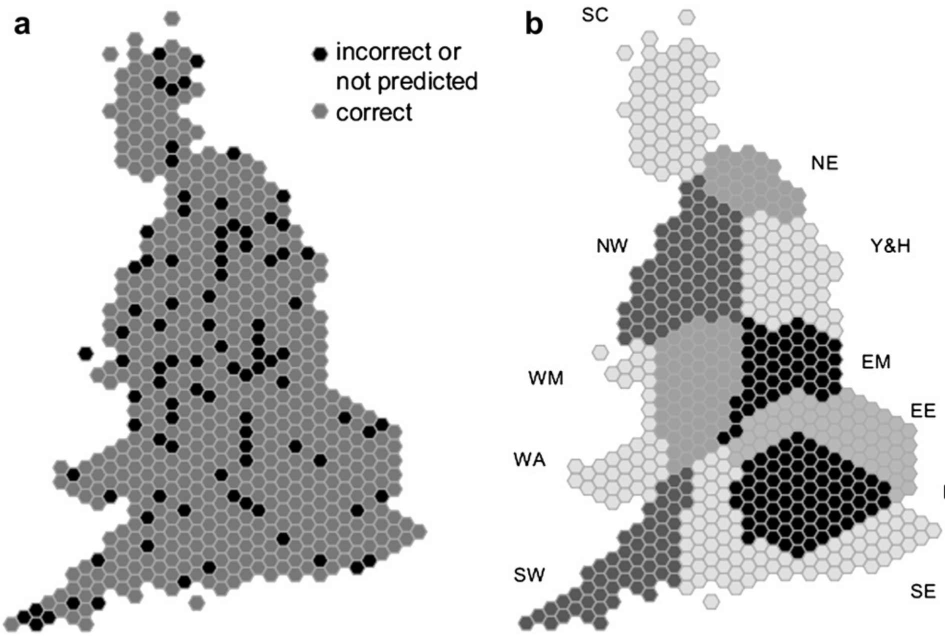

Fig. 2. (a) Mapping the forecast performance of the range voting procedure for the 2010 General Election. The code for this map is adapted from Craft (2010) who converted the Flash-files of the BBC (2010) website to javascript. (b) The right panel shows the British census regions.

plurality voting or range voting is used to yield group forecasts. However, this is not to say that groups are always better than individuals; in some constituencies groups get it wrong, whereas some individuals correctly predicted the winner. Having looked at the binary case of correct/incorrect forecasts, an even more interesting question is whether groups can forecast parties' national seat shares. The following subsection examines this question.

4.2. How accurate is the seat prediction of citizen forecasting?

The previous subsection showed the greater accuracy of group predictions compared with individual's predictions. The following paragraphs analyse the accuracy of citizen forecasting more thoroughly by examining (1) the national election outcome in general, and (2) the mean absolute error in making seat predictions in particular.

Having a forecasted winner in each constituency allows one to count the number of constituencies each party is forecasted to win. In other words, citizen forecasting yields a forecast of the national seat number of each party. Comparing this forecasted seat number with the actual seat number allows to assess the forecasting accuracy.

How well does citizen forecasting predict the national election outcome? Table 2 displays the forecasted seats won, the actual seats won, and the error in seats for each of the five main parties using both the plurality and the range voting procedure. It turns out that both voting procedures correctly predict a hung parliament with the Conservatives as the largest party. Although both voting procedures get the national election outcome right, they differ in the accuracy of their forecasted seat numbers.

Focusing on the three main parties first, range voting is much more accurate than plurality voting. For all three main parties, range voting is always closer than plurality voting to the actual outcome. For instance, both parties underestimate the Conservative seat number. But range voting does so only by 14 seats, whereas plurality voting does so by 25 seats. Accordingly, the mean absolute error for the three main parties for range voting is only $(14+1+8)/3 = 7.7$ seats, whereas this value doubles for plurality voting to $(25+8+12)/3 = 15$ seats.

Besides the three main parties, Table 2 also shows the forecasting results for Plaid Cymru and the Scottish National Party. Both plurality voting and range voting overestimate the Scottish National Party seat number by 4 seats. For Plaid Cymru, plurality voting gets it nearly spot on, overestimating it only by 1 seat. In contrast, range voting forecasts that Plaid Cymru wins double the number of seats they actually won—range voting overestimates Plaid Cymru's seat number by 3 seats. Including this information yields a mean absolute error for all five parties for range voting of $(14+1+8+3+4)/5 = 6$ seats and for plurality voting of $(25+8+12+1+4)/5 = 10$ seats.

Both voting procedures correctly predicted about the same number of constituencies. But range voting yields a more accurate national seat share forecast than plurality voting. Therefore, the difference in the predictive power comes from the set of incorrectly forecasted constituencies. In this set, range voting mirrors more closely the actual seat share distribution than does plurality voting. However, there is nothing in the range voting procedure that leads one to expect that range voting will always outperform plurality voting in this set. It seems appropriate to apply both aggregating procedures to get some estimate of the predictive uncertainty in national seat shares.

To sum up, regardless of which voting procedure is used, citizen forecasting correctly predicts a hung parliament with the Conservatives as the largest party. Both forecasted seat distributions closely mirror the actual seat distribution. However, range voting forecasts more accurately than plurality voting the seat numbers won by each party.

Table 2
Forecast and actual seats using the plurality voting and range voting procedure. The 11 tied constituencies in the plurality voting procedure are decided by a random draw.

Party	Plurality voting			Range voting		
	Forecast seats won	Actual seats won	Error in seats	Forecast seats won	Actual seats won	Error in seats
Conservatives	279	304	−25	290	304	−14
Labour	265	257	+8	256	257	−1
LibDems	69	57	+12	65	57	+8
PC	4	3	+1	6	3	+3
SNP	10	6	+4	10	6	+4
N		627			627	
$MAE_{All\ 5\ Parties}$		10			6	
$MAE_{Main\ 3\ Parties}$		15			7.7	

Note: Results are based on the pre-election internet survey of the 2010 British Election Study. Results are only computed for the 627 constituencies that were won by one of the "main" five parties—Conservatives, Labour, Liberal Democrats, Plaid Cymru and the Scottish National Party. The constituency level results for expectations uses the question "On a scale that runs from 0 to 10, where 0 means very unlikely and 10 means very likely, how likely is it that [the name of the party] will win the election in your local constituency?" for each party and aggregates the responses for each constituency. MAE stands for mean absolute error and is based on the numbers calculated in the "Error in seats"-column.

4.3. Can groups forecast parties' vote shares?

The previous sections show that groups correctly forecast the winning party in about 85 percent of the constituencies in 2010. However, a more difficult test is the following: can groups forecast parties' vote shares? The following paragraphs examine whether the percent who thought that the party would win (the *group forecast score*), can forecast (1) the vote shares of the winning party, and (2) vote shares of the three main parties—the Conservatives, Labour, and the Liberal Democrats.[4] It turns out that the group forecast score accurately predicts parties' vote shares.

To begin with, can the group forecast score predict the winning party's vote share? A relationship between the two variables seems possible because some citizens get it wrong. To see this, consider the two extremes of *perfect* and *random* forecasters. If everybody in the group was a perfect forecaster, everybody in the group would think that the

[4] I focus the analysis on these three parties because they are the only ones competing nationally.

winning party would win. In this case, the group forecast score carries no information about the winning party's vote share. Plotting the winning party's vote share on the vertical axis against the group forecast score on the horizontal axis would yield a vertical line.

In the other extreme case of *random* forecasters, plotting the winning party's vote share against the group forecast score would yield a horizontal line—again carrying no information. Consider a two party competition. If people had a 50 percent chance of getting it right, the number of correct forecasters in the group will not tell us anything about what to expect about the winning party's vote share. Yet, if people fall between those two extremes, the group forecast score informs us about the winning party's vote share. The functional relationship falls between a horizontal and a vertical line and seems to be best described by an exponential relationship—the higher the forecast score, the more informative its value.

Fig. 3 supports this expectation. Fig. 3 displays a scatterplot, with the winner's group forecast score on the horizontal axis, and the logarithm of the actual winning party's total vote share on the vertical axis.[5] A non-linear regression line is fitted to the plot. As expected, the relationship appears strong and positive. The actual regression estimate (OLS) confirms this finding (standard errors in parentheses):

$$\log(S) = \underset{(0.04)}{-0.91} - \underset{(0.13)}{0.07 \cdot W} + \underset{(0.10)}{0.34 \cdot W^2} + e,$$

$$N = 627; Adj.R^2 = 0.28$$

where S denotes the total vote share of the winning party; W equals the proportion of people in the constituency that thought that the party would win; e stands for the error term; the figures in parentheses are the standard errors; R^2 denotes explained variance; and N indicates the number of constituencies.

Further analysis reveals that the number of parties affects the shape of the relationship between the group forecast score and the winning party's vote share (no table shown). For five or more parties the same non-linear functional form as shown above describes the data best; however, for three or four competing parties, the relationship is linear. The mechanism behind this interaction effect may be that information costs increase with the number of competing parties. "Wishful thinking" of the uninformed compounds this effect—when the costs of getting informed are too high, they may predict their favourite party to win. Independent evidence for this mechanism comes from the literature on electoral systems and turnout (Blais and Carty, 1990; Long Jusko and Shively, 2005). In contrast to expectations, the number of parties in proportional representation systems decreases turnout. To explain this finding, Blais and Carty (1990), and Long Jusko and Shively (2005) argue that more competing parties increase the costs of getting informed and therefore lower the expected net utility from voting.

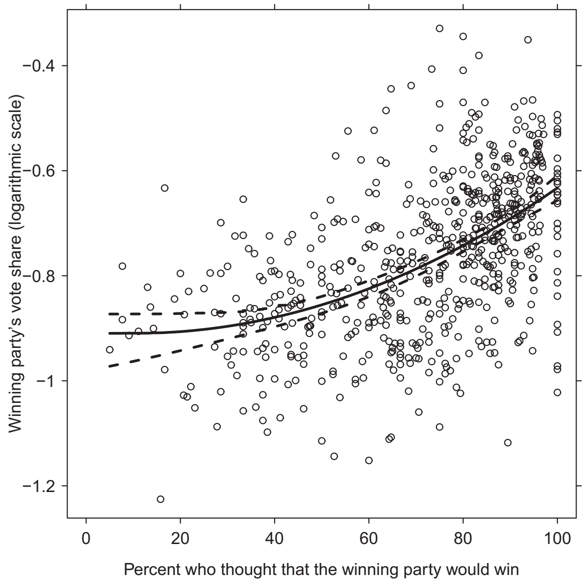

Fig. 3. UK parliamentary election 2010 – votes shares at the constituency level. The solid line depicts the regression line; the dashed lines indicate the 95 percent confidence intervals.

To move on to forecasting each party's vote share, Fig. 4 plots the votes shares for each of the three main parties against the percentage of constituents who thought that it would win. A regression line is added to each plot. As Table 3 shows, all three regression coefficients of the group forecast scores are statistically significant at the 0.01 level and substantively significant too. For all three parties, an increase of one percent of people who think that the party would win is associated with a predicted 0.4 percent increase in that party's vote share. High R^2 values for the Conservatives (0.76) and Labour (0.74) underscore this strong relationship. The R^2 is smaller for the Liberal Democrats, though its value of 0.57 is still high.[6]

4.4. Why can groups forecast?

The previous subsections have shown that most groups can correctly forecast the winning party in their constituency. Mapping the forecasting performance also indicated that some regions where better than others in forecasting. What can explain correct forecasts? What can explain why some regions overperform? The following tries to answer

[5] I use the logarithmic transformation of the actual vote share to remedy non-constant error variance. After transforming the dependent variable both the Breusch-Pagan Lagrange Multiplier test ($p = 0.66$) and the more general White-test ($p = 0.59$) fail to reject the null hypothesis of constant variance.

[6] Running a similar model for the US presidential elections from 1956 to 1996, Lewis-Beck and Tien (1999) estimate the following relationship: V = 39.45 + 0.21 F + e, with V = incumbent vote share, F = percent who thought that the incumbent would win, and e = error term. In contrast to the estimates presented here, their estimated constant is nearly twice as big and their estimated coefficient half in size. Nevertheless, the estimates seem plausible because only two parties really compete for the US presidency, whereas three main parties compete in most constituencies in UK parliamentary elections. Therefore, the vote share of each party symbolised by the constant should be lower in the UK than in the US, whereas the slope should be steeper. I would like to thank the first reviewer for suggesting to compare the UK with the US results.

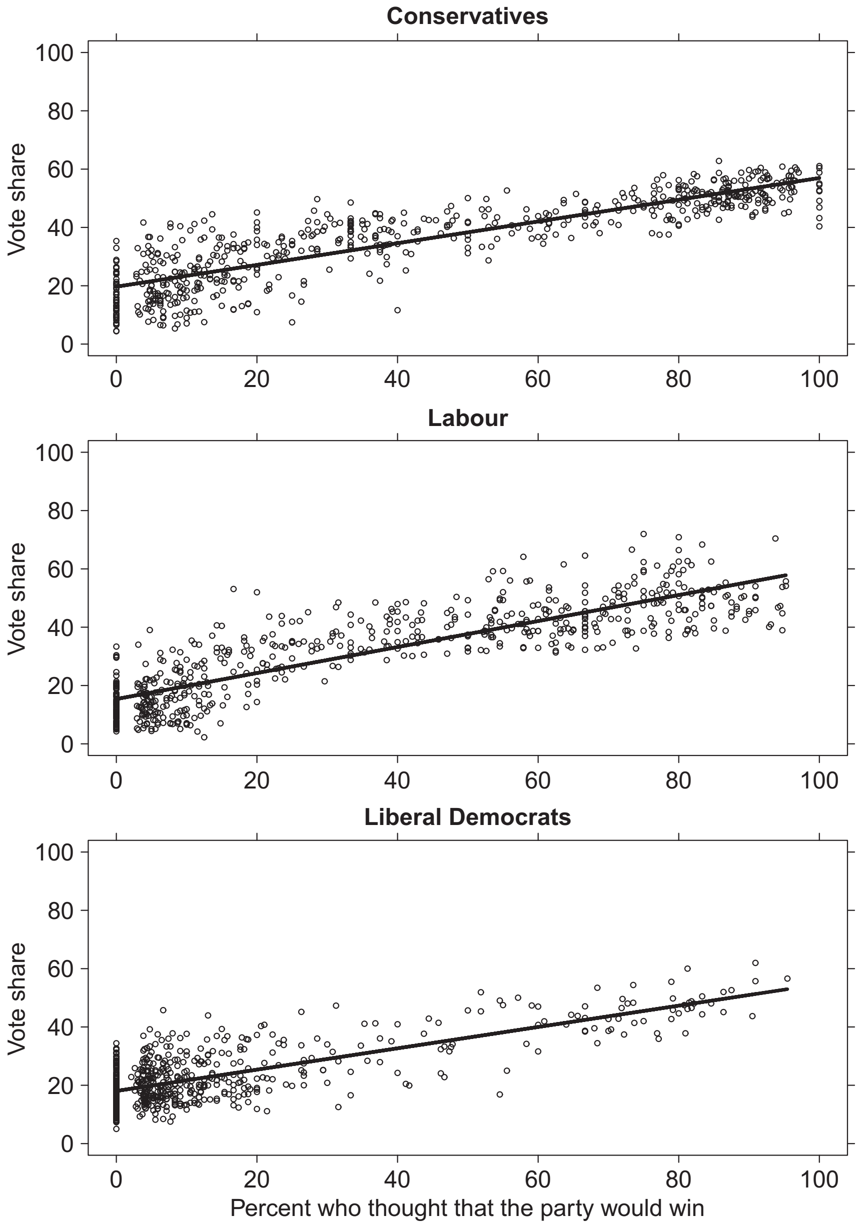

Fig. 4. Vote shares for the three main party plotted against the percentage of people who thought that the party would win. Straight lines represent OLS regression lines.

these questions by exploring "tasks difficulty" and "group characteristics".

To begin with "task difficulty", elections vary in how easy they are to forecast. The easier elections are, the higher the chances of getting it right. What makes an election easy or hard to forecast? I propose several objective measures of task difficulty. These objective measures fall into two broad categories—characteristics of the electorate and the degree of party competition. The following paragraphs describe each of these categories in more detail.

If the electorate is stable in terms of both size and composition, the election should be easy to predict—people can just infer from its past behaviour to its future behaviour. However, *boundary changes* may greatly change the size and composition of a constituency rendering past election results useless for predictions.[7] Even if boundaries remain the same, the voting population may change. If *turnout* stays the same it seems likely that the same people voted as in the previous election. In contrast, if turnout decreases or increases a lot, then many people have left or joined the electorate making it difficult to rely on past

[7] For a detailed study of boundary reviews see Rossiter et al. (1999).

Table 3
Estimated coefficients and standard errors for OLS regression for each of the three main parties' constituency vote share on the percentage who that that the party would win in the constituency.

	Conservatives	Labour	Liberal Democrats
Constant	19.68[a]	15.36[a]	18.05[a]
	(0.46)	(0.49)	(0.33)
% thought party would win	0.37[a]	0.45[a]	0.37[a]
	(0.01)	(0.01)	(0.01)
N	627	627	627
Residual standard error	7.13	8.16	6.86
R^2	0.76	0.74	0.57

[a] $p \leq 0.05$; Standard errors in parentheses.

election results. Finally, if an electorate changes its behaviour, an observer can easily notice this change if the electorate is small—the larger the *size of the electorate*, the more difficult it is to predict where things are going.

Besides the electorate, the degree of party competition affects the forecasting difficulty. The two important variables are the *winning margin* in 2010 and the *number of competing parties*.[8] The winning margin is a direct measure of how easy the election was. In a landslide victory, the winning party is easier to predict than in a close election between three parties. Similarly, the more parties compete in the electoral arena, the harder correct forecasting becomes—the number of parties increases the costs of making an informed prediction. If many parties compete, people are less likely to inform themselves as they would with fewer parties and therefore the chances of making a correct forecast decrease.

Although the task difficulty is important, groups may vary in their ability to solve these tasks. Surowiecki (2004) argues that *groups size* and *diversity* are key predictors of groups' success rate. More people in a group ensure different perspectives and information to bear on the problem. Moreover, larger groups ensure that errors cancel each other out by aggregating the responses. However, it is easy to imagine a large enough group made of similar individuals that do not differ much in their outlook. Therefore diversity is a more direct measure of the underlying idea. But on what characteristics should members in a group differ? Surowiecki (2004) indicates that cognitive diversity trumps sociological diversity, without clearly specifying what cognitive diversity means. What seems relevant is informational diversity as specified by education, newspaper reading, attention to politics, and interest in the election (Luskin, 1990). In addition, I also include the variation in response dates within the constituency. The more people vary in their response date, the more likely they should be to pick up different pieces of information that are relevant for the election. To sum up Surowiecki's argument, he claims that a group of experts makes worse predictions than a group with a lower informational mean but higher diversity. Because Surowiecki

[8] Using the winning margin of 2005 yields similar results.

Table 4
Explaining correct group predictions. Logistic regression model with variables relating to "task difficulty" and "group characteristics".

	Estimate	Std. Error
(Intercept)	−2.27	(4.19)
TASK DIFFICULTY		
Boundary change	0.01	(0.01)
Margin	0.18[a]	(0.02)
Abs. change in turnout	0.02	(0.05)
Size of electorate	−0.24	(0.20)
Number of parties	−0.10	(0.19)
GROUP CHARACTERISTICS		
Decision making		
Group Size	0.08[a]	(0.03)
Informational diversity		
Education	0.26	(0.74)
Interest	0.67	(0.85)
Attention	−0.43	(0.87)
Newspaper	−0.94	(1.73)
Response date	1.21[a]	(0.42)
Sociological diversity		
Age	0.05	(0.06)
Female	−1.57	(3.66)
Income	−0.02	(0.77)
N	627	
AIC	393.09	
BIC	659.55	
log L	−136.55	
Area under ROC curve	86.3%	

[a] Significance at $p < 0.05$; Standard errors in parentheses.

(2004) argues that sociological diversity should have no impact I include age, gender, and income to test that prediction.

How to measure diversity? Following studies about the impact of group diversity on work performance (Jehn et al., 1999: 749), I use for categorical variables an entropy-based index to capture diversity within groups:

$$Diversity = \sum -P_i(\ln P_i),$$

where P_i denotes the proportion of the group that has the i th diversity characteristic. If nobody in the group has a characteristic, P_i becomes 0. Thus, the diversity index is the negative sum of the products of each characteristic's proportion in the group and the natural logarithm of its proportion (Shannon and Weaver, 1949). The higher the diversity index, the greater the distribution of characteristics within the group. Consider a group of 10 members. With 5 females and 5 males, the diversity index is 0.69.[9] If all ten members are female, the diversity index is 0. If 8 are female and 2 are male, the diversity is 0.5. For the interval-scaled variables age and date of response, their standard deviation indicates the diversity. The appendix shows the coding of all the variables used together with summary statistics.

Table 4 presents the result of a logistic regression of correct predictions on variables relating to "task difficulty"

[9] In this example, 5 out of 10 observations are female. Therefore, $P_{\text{female}} = 0.5$ and $P_{\text{male}} = 0.5$. It follows that the diversity index is $-P_{female}(\ln P_{female}) - P_{male}(\ln P_{male}) = -0.5(\ln 0.5) - 0.5(\ln 0.5) = 0.35 + 0.35 = 0.69$.

and "groups characteristics". Looking first at "task difficulty", the margin of victory has the only statistically significant impact of this group of variables on making correct predictions ($\beta = 0.18$, $s.e.(\beta) = 0.02$, $p < 0.05$), which indicates that the wider the winning margin is, the higher the probability of a correct prediction. An increase in the winning party's margin by one percent increases the probability of correctly forecasting the winner by a maximum of five percent (calculated the divide by four rule proposed by Gelman and Hill (2009): $0.18/4 = 0.05$). For instance, a winning margin of 10 percent instead of 5 percent increases a group's probability of correctly forecasting at maximum by 25 percent. Yet, even when parties win with a margin of less than five percent, citizen forecasting still correctly predicts 46 of 87 constituencies (53 percent).

Moving to "group characteristics", only group size and the variation in response dates are statistically significant predictors for getting the prediction right. The coefficient of group size is positive ($\beta = 0.08$, $s.e.(\beta) = 0.03$, $p < 0.05$). Therefore, the bigger the group, the more likely it is that the group correctly forecasts. Using again the divide by four rule, adding one additional person to the group increases the probability of correctly forecasting by at maximum two percent ($0.08/4 = 0.02$). Hence, increasing a group size by 10 people raises the probability of a correct forecast by at maximum 20 percent.

It seems interesting to examine how many members a group would need to forecast correctly a marginal seat. I estimated this probability and the uncertainty around it for two group sizes looking only at winning margins of less than 5 percent, while holding other variables at their means (King et al., 2000; Imai et al., 2008). Fig. 5 illustrates that group size helps to get even close elections right. The probability of making a correct forecast is always greater for a group size of 60 compared with a group size of 20. Even for a winning margin of only one percent, the bigger group has a greater than 60 percent probability of getting it right, whereas the smaller group has only at maximum a 50 percent probability of getting it right. The figure also reveals that uncertainty with the expected value is greatest for the group size of 60—the vertical bars, which represent 95 percent confidence intervals, are longer for them than for the group size of 20. This increased uncertainty is due to the fact that the maximum observed group size is 51. However, this counterfactual shows what group sizes would be needed in future studies to forecast marginal constituencies with a given probability.

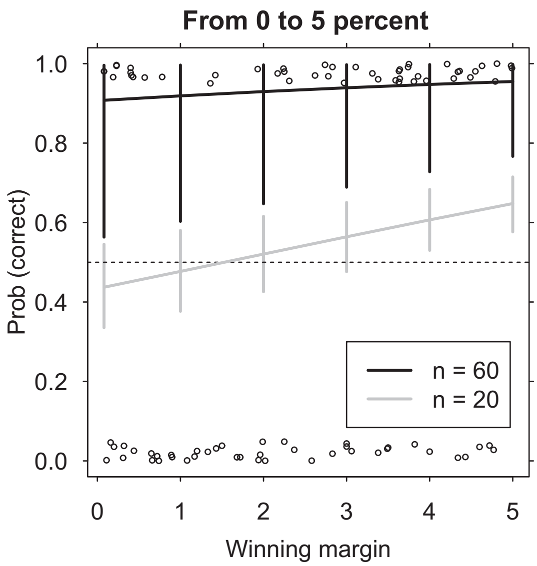

Fig. 5. Probability of making a correct forecast by winning margin and group size. Vertical bars indicate 95 percent confidence intervals. Jittered data overlain.

Besides group size, the only "group characteristic" that is statistically significant is the variation in response dates. As expected, greater variation in response dates increases the probability of making a correct forecast ($\beta = 1.21$, $s.e.(\beta) = 0.42$, $p < 0.05$). Increasing the standard deviation of response dates within a constituency by one day raises the probability of making a correct forecast by at maximum 30 percent ($1.21/4 = 0.3$).[10] The effect of the variation in response dates seems rather big. A 30 percent increase in probability suggests the biggest effect among all three variables predicted by a one unit increase. However, increasing the standard deviation of response dates by one day covers the whole range of that variable. About 90 percent of all standard deviations in response dates lie between 2.5 and 3.5 days.

In contrast to group size and response date, all other "group characteristics" are statistically insignificant. As expected, sociological diversity has no impact; however, it comes somewhat as a surprise that the remaining informational diversity-variables fail to increase the group's chances of a correct forecast.[11]

[10] What does it mean substantively to increase the standard deviation of response dates by one day? Consider the following example. Let's assume that responses in a constituency are normally distributed. The mean response date equals 50 days before the election and the standard deviation changes from 2 to 3 days. The normal distribution implies that 95 percent of the set lie within ± 2 standard deviations around the mean. Therefore, with 2 days standard deviation, our survey finishes 95 percent of the interviews between the 46th and 54th day before the election ($50 \pm (2 \cdot 2) = [46; 54]$). In contrast, increasing the standard deviation by one day from 2 to 3 days means interviewing 95 percent of the sample between the 44th and 56th day before the election ($50 \pm (2 \cdot 3) = [44; 56]$). Therefore, increasing the standard deviation by one day in this example spreads out the interviews to four more days.

[11] I tried three other specifications of informational and sociological diversity but they all yielded the above results. First, I added the relevant diversity scores to yield an aggregate score. For informational diversity, I added the diversity scores for education, interest, attention and daily newspaper reading. For sociological diversity, I added the diversity scores for age, gender and income. Second, I computed a factor analysis for the four informational diversity scores—education, interest, attention and daily newspaper reading. The factor scores replaced these variables in the regression. Finally, for both sets of variables, I computed the mean Gower-coefficient in each constituency (Gower, 1971). The Gower-coefficient is a measure of dissimilarity between two objects based on variables that vary in their level of measurement. The more dissimilar two objects are, the higher the Gower-coefficient. The mean of all Gower-coefficients in each constituency is therefore another measure of group diversity. In all three cases, both informational and sociological diversity were statistically insignificant.

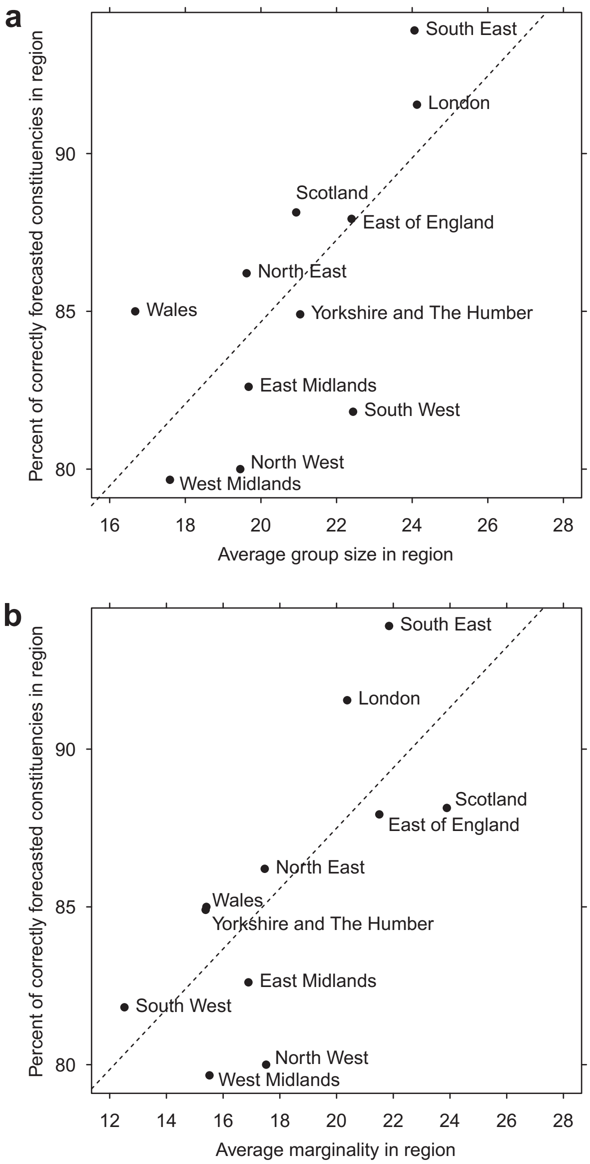

Fig. 6. Explaining share of correctly forecasted constituencies in regions. (a) Plot of percent of correctly forecasted constituencies against the average group size in region. (b) Plot of percent of correctly forecasted constituencies against the average marginality in region. Dotted lines represent bivariate regression lines.

In short, the three main reasons why groups get it right is the party's margin of victory, the group size, and variation in response dates. Landslides are easier to convert into a correct prediction than close elections. But bigger groups and varying response dates help to get even close elections right. Having analysed why groups correctly forecast, can these findings also explain why regions vary in their performance? The following focuses on marginality and group size because all regions are identical in their average mean standard deviation. Therefore, variation in response dates cannot explain regional variation in forecasting performance.[12] In contrast, regions varied in average group size and average winning margin.

Fig. 6a plots the share of correctly forecasted constituencies within a region against the average group size in that region. Fig. 6a shows that the share of correctly forecasted constituencies increases with the average group size. The West Midlands and the North West are among the regions with the lowest average group size. They interviewed less than 20 people on average in their constituencies. This small average group size is associated with less than 80 percent correctly forecasted constituencies. In contrast to that, the average group size in London and the South East was more than 23 people on average. This average group size raises the share of correct forecasts to more than 90 percent. All points in the scatterplot fall close to the bivariate regression line. The biggest exception to this pattern, however, is the South West. This region has a much lower share of correct forecasts than expected from its average group size. Close elections in that region explain much of the deviation, as Fig. 6b shows.

Fig. 6b depicts the share of correct forecasts as a function of average marginality. Fig. 6b shows a strong positive relationship between average marginality and the share of correct forecasts. The South West, the West Midlands, and the North West are among the regions with the closests elections. In the South West, the winning parties won on average by less than 13 percent. This low winning margin is associated with correct forecasts in about 8 out of 10 constituencies. In contrast, the winning parties in Scotland and the South East won on average by more than 20 percent. These landslides are associated with correct forecasts in 9 out of 10 constituencies.

To sum up, regions varied in their forecasting performance. At a minimum, the West Midlands correctly predicted about 80 percent of its constituencies; at a maximum, the South East correctly predicted about 95 percent of its constituencies. Much of this variation seems to be explained by the average group size and average marginality in the regions.

5. Conclusion

The studies on citizen forecasting show that citizens are very good in forecasting the national election outcome (Lewis-Beck and Skalaban, 1989; Lewis-Beck and Tien, 1999; Lewis-Beck and Stegmaier, 2011). The present research applies the citizen forecasting idea to constituencies rather than the nation itself. Forecasting each constituency allows to test the model in more cases and to translate local expectations into a national seat forecasts. Independent of the aggregation method used, citizen forecasting correctly predicted about 85 percent of all constituencies. Combining the constituency forecasts into a seat forecast correctly predicted a hung parliament with the Conservatives as the largest party. In addition, citizen

[12] All regions have a mean standard deviation in response dates of 2.9 or 3.0 and there is little variation in response dates between constituencies within regions.

forecasting also closely mirrored parties' local vote shares. Therefore, citizen forecasting has two main advantages of citizen forecasting compared to other forecasting models. First, citizen forecasting can directly forecast seat shares. Second, citizen forecasting can forecast parties' local vote shares.

Although citizen forecasting was in general very accurate, it sometimes got it wrong. About 15 percent of the constituencies were incorrectly predicted. Further, regions varied in their share of correct forecasts. This variation was mainly related to group size and the party's winning margin—large groups and landslides help to get it right. Therefore, it seems important to equalise the number of respondents across constituencies to ensure similar forecasting ability. Nevertheless, in constituencies that are likely to be close, an increased group size could counterbalance the higher difficulty. The estimates presented here allow to calculate the group size needed to correctly forecast a marginal constituency with a given probability. Because citizens are also good at forecasting parties' local vote shares, they can also forecast which elections will be close. This ability allows to adopt a dynamic sampling approach to determine the group size in each constituency—if citizen forecasting predicts a close election, increase the sample size more than planned; if otherwise, sample as planned.

An extension of the citizen forecasting model could incorporate campaign effects. Does campaigning distort citizens' expectations? Do groups still get it right if the losing party campaigned more than the winning party? Parties contact citizens to persuade them to vote for them. Part of this endeavour is to convince the contacted person that the party has a chance of winning. Further, being contacted by a party signals a strong party organisation that has the capability to run a decent campaign. Campaign effects may change citizens' expectations for good or bad. If the winning party contacts the respondents, this may set her on the right track. If both the winning and one or more of the losing parties contact the respondent, this may result in confusion. Similarly, if only one or more of the losing parties contact him or her, this may send a "wrong" signal to the respondent—she may expect the losing party to win. Aggregating the individual expectations may cancel the errors out. However, if the losing party campaigned harder than the winning party, this may sway groups to forecasting the wrong party to win. Therefore, it seems worthwhile for future research to explore how campaigning affects individuals' and groups' ability to forecast correctly.

Given the success of citizen forecasting using local expectations, it seems beneficial to replicate it across time and space. The present research showed that citizen forecasting yields accurate results even before the campaign has started. Citizen forecasting, however, could also be used on election day in exit polls (cf. Curtice and Firth, 2008). The pre-campaign BES internet survey can serve as a template for data collection. Studies should ensure, however, that they cover all constituencies and that all constituencies are represented by a large enough number of respondents—to make sure that the "wisdom of crowds"-effect kicks in. Having said that, it seems that in most cases about 20 respondents suffice to have a much greater than 50 percent chance of getting it right.

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Appendix A. Coding of variables

The list below provides definitions for the individual-level variables used to compute group characteristics:

- *Age*: Age of respondent.
- *Attention:* Responses to "On a scale of 0–10, how much attention do you generally pay to politics?" ranging from 0 = "Pay no attention" to 10 = "Pay a great deal of attention".
- *Education:* Age the person finished his/her education.
- *Female:* Gender of respondent (0 = "male", 1 = "female").
- *Income:* Responses to "Which of the following represents the total income of your household from all sources before tax – including benefits, saving and so on?" ranging from 1 = "Less than £5000" to 16 = "More than £100,000".
- *Interest:* Responses to "How interested are you in the general election that will be held soon?" ranging from 1 = "Not at all interested" to 4 = "Very interested".
- *Newspaper:* Responses to "How often do you read a daily morning newspaper - either the paper version or online?" ranging from 1 = "Not at all" to 3 = "Everyday".
- *Response date:* Number of days until election when the respondent completed the survey.

The list below provides definitions for the constituency-level variables used as covariates in the regression:

- *Absolute change turnout:* Absolute change in turnout in 2010 compared with 2005.
- *Boundary change:* Based on the index of change from Rallings and Thrasher (2007). The index of change is the sum of total deletions from base and total additions to base, divided by the electorate of base constituency. The base constituency is the old constituency that contributes most electors to the new constituency.
- *Group size:* Number of people who made an unambiguous forecast.
- *Margin:* The margin by which the winning party won in 2010.
- *Number of parties:* Number of competing parties in the constituency.
- *Size of electorate:* The number of eligible voters in the electorate in 10,000.

Appendix B. Summary statistics for variables

Table 1A
Summary statistics.

	Min	Max	Mean	Std. dev.
Correctly forecasted	0.00	1.00	0.86	0.35
Boundary change	0.00	135.89	17.78	25.93
Margin	0.08	57.72	18.39	12.02
Abs. change in turnout	0.06	31.11	4.45	2.93
Size of electorate	2.18	10.99	7.03	0.77
Number of parties	3.00	7.00	5.10	0.73
Groupsize	4.00	51.00	21.06	6.50
Education diversity	0.34	1.60	1.31	0.20
Interest diversity	0.40	1.34	0.97	0.17
Attention diversity	1.04	2.31	1.88	0.18
Newspaper diversity	0.24	1.10	1.01	0.09
Response date (std. dev.)	1.14	3.67	2.91	0.30
Age (std. dev.)	5.85	19.02	13.94	2.06
Female diversity	0.38	0.69	0.66	0.04
Income diversity	0.69	2.60	2.10	0.24

References

Asch, S.E., 1955. Opinions and social pressure. Scientific American 193, 33–35.
Bélanger, É, Lewis-Beck, M.S., Nadeau, R., 2005. A political economy forecast for the 2005 British general election. British Journal of Politics & International Relations 7, 191–198.
BBC, 2010. National election results 2010 Available at: http://news.bbc.co.uk/2/shared/election2010/results/.
Blais, A., Carty, R.K., 1990. Does proportional representation foster voter turnout? European Journal of Political Research 18, 167–181.
Blais, A., Gidengil, E., Fournier, P., Nevitte, N., Hicks, B.M., 2008. Measuring expectations: comparing alternative approaches. Electoral Studies 27, 337–343.
Boland, P.J., 1989. Majority systems and the Condorcet jury theorem. The Statistician 38, 181–189.
Borisyuk, R., Galina, B., Rallings, C., Thrasher, M., 2005. Forecasting the 2005 general election: a neural network approach. The British Journal of Politics & International Relations 7, 199–209.
Campbell, J.E., Garand, J.C. (Eds.), 2000. Before the Vote: Forecasting American National Elections. Sage, Thousand Oaks.
Chamley, C., 2004. Rational Herds: Economic Models of Social Learning. Cambridge University Press, Cambridge.
Condorcet, Marquis de, M.J.A.N.d.C, 1785. Essai sur l'application de l'analyse a la probabilité des descisions redues a la pluralité de voix. De l'Imprimerie Royale, Paris.
Condorcet, Marquis de, M.J.A.N.d.C., 1994. Essay on the application of probability analyses to decisions returned by a plurality of people. In: McLean, I., Hewitt, F. (Eds.), Condorcet: Foundations of Social Choice and Political Theory. E. Elgar, Aldershot, pp. 11–36 (Original work published 1785).
Converse, P.E., 1964. The nature of belief systems in mass politics. In: Apter, D.E. (Ed.), Ideology and Discontent. Free Press of Glencoe, London, pp. 206–261.
Converse, P.E., 1990. Popular representation and the distribution of information. In: Ferejohn, J.A., Kuklinski, J.H. (Eds.), Information and Democratic Processes. University of Illinois Press, Urbana and Chicago, pp. 369–388.
Craft, T., 2010. Proportional election maps, without Flash. Available at: http://timcraft.com/2010/05/09/electionmap.
Curtice, J., Firth, D., 2008. Exit polling in a cold climate: the BBC–ITV experience in Britain in 2005. Journal of the Royal Statistical Society: Series A (Statistics in Society) 171, 509–539.
Estlund, D.M., 1994. Opinion leaders, independence, and Condorcet's jury theorem. Theory and Decision 36, 131–162.
Fischhoff, B., MacGregor, D., 1982. Subjective confidence in forecasts. Journal of Forecasting 1, 155–172.
Galton, F., 1907. Vox populi. Nature 75, 450–451.
Gelman, A., Hill, J., 2009. Data Analysis Using Regression and Multilevel/Hierarchical Models. Cambridge University Press.
Gower, J.C., 1971. A general coefficient of similarity and some of its properties. Biometrics 27, 857–871.
Grofman, B., Owen, G., Feld, S.L., 1983. Thirteen theorems in search of the truth. Theory and Decision 15, 261–278.
't Hart, P., 1994. Groupthink in Government: A Study of Small Groups and Policy Failure. Johns Hopkins University Press, Baltimore.
Hastie, R., Kameda, T., 2005. The robust beauty of majority rules in group decisions. Psychological Review 112, 494–508.
Hogarth, R.M., 1978. A note on aggregating opinions. Organizational Behavior and Human Performance 21, 40–46.
Imai, K., King, G., Lau, O., 2008. Zelig: Everyone's Statistical Software. Available at: http://gking.harvard.edu/zelig.
Janis, I.L., 1982. Groupthink: Psychological Studies of Policy Decisions and Fiascoes. Houghton Mifflin, Boston.
Jehn, K.A., Northcraft, G.B., Neale, M.A., 1999. Why differences make a difference: a field study of diversity, conflict, and performance in workgroups. Administrative Science Quarterly 44, 741–763.
King, G., Tomz, M., Wittenberg, J., 2000. Making the most of statistical analyses: improving interpretation and presentation. American Journal of Political Science 44, 341–355.
Koriat, A., Lichtenstein, S., Fischhoff, B., 1980. Reasons for confidence. Journal of Experimental Psychology: Human Learning and Memory 6, 107–118.
Ladha, K.K., 1992. The Condorcet jury theorem, free speech, and correlated votes. American Journal of Political Science 36, 617–634.
Larrick, R.P., Soll, J.B., 2006. Intuitions about combining opinions: misappreciation of the averaging principle. Management Science 52, 111–127.
Lewis-Beck, M.S., 2005. Election forecasting: principles and practice. British Journal of Politics & International Relations 7, 145–164.
Lewis-Beck, M.S., Skalaban, A., 1989. Citizen forecasting: can voters see into the future? British Journal of Political Science 19, 146–153.
Lewis-Beck, M.S., Stegmaier, M., 2011. Citizen forecasting: Can UK voters see the future? Electoral Studies 30, 264–268.
Lewis-Beck, M.S., Tien, C., 1999. Voters as forecasters: a micromodel of election prediction. International Journal of Forecasting 15, 175–184.
List, C., Goodin, R.E., 2001. Epistemic democracy: generalizing the Condorcet jury theorem. Journal of Political Philosophy 9, 277–306.
Long Jusko, K., Shively, W.P., 2005. Applying a two-step strategy to the analysis of cross-national public opinion data. Political Analysis 13, 327–344.
Luskin, R., 1990. Explaining political sophistication. Political Behavior 12, 331–361.
Meehl, P.E., 1957. When shall we use our heads instead of the formula? Journal of Counseling Psychology 4, 268–273.
Miller, N.R., 1986. Information, electorates, and democracy: some extensions and interpretations of the Condorcet jury theorem. In: Grofman, B., Owen, G. (Eds.), Information Pooling and Group Decision Making. JAI Press, Greenwich, pp. 173–192.
Mueller, D.C., 1989. Public Choice II. Cambridge University Press, Cambridge.
Mughan, A., 1987. General election forecasting in Britain: a comparison of three simple models. Electoral Studies 6, 195–207.
Norpoth, H., 2004. Forecasting British elections: a dynamic perspective. Electoral Studies 23, 297–305.
Page, B.I., Shapiro, R.Y., 1992. The Rational Public: Fifty Years of Trends in Americans' Policy Preferences. University of Chicago Press, Chicago.
Rallings, C., Thrasher, M. (Eds.), 2007. Media Guide to the New Parliamentary Constituencies. LGC Elections Centre for BBC, ITN, PA. News and Sky, Plymouth.
Rossiter, D.J., Johnston, R.J., Pattie, C.J., 1999. The Boundary Commissions: Redrawing the UK's Map of Parliamentary Constituencies. Manchester University, Manchester.
Sanders, D., 1991. Government popularity and the next general election. The Political Quarterly 62, 235–261.
Sanders, D., 2005. Popularity function forecasts for the 2005 UK general election. The British Journal of Politics & International Relations 7, 174–190.
Shannon, C.E., Weaver, W., 1949. The Mathematical Theory of Communication. University of Illinois Press, Urbana and Chicago.
Smith, W.D., 2000. Range voting. Available at: http://math.temple.edu/wds/homepage/rangevote.pdf.
Surowiecki, J., 2004. The Wisdom of Crowds. Abacus, London.
Tufte, E.R., 1973. The relationship between seats and votes in two-party systems. The American Political Science Review 67, 540–554.
von Hayek, F.A., 1945. The use of knowledge in society. American Economic Review 35, 519–530.
Whiteley, P.F., 1979. Electoral forecasting from poll data: the British case. British Journal of Political Science 9, 219–236.
Whiteley, P.F., 2005. Forecasting seats from votes in British general elections. British Journal of Politics & International Relations 7, 165–173.
Whiteley, P.F., 2008. Evaluating rival forecasting models of the 2005 general election in Britain: an encompassing experiment. Electoral Studies 27, 581–588.
Whiteley, P.F., Sanders, D., Stewart, M., Clarke, H., 2011. Aggregate level forecasting of the 2010 general election in Britain: The seats-votes model. Electoral Studies 30, 278–283.