An investigation into the psychological, cognitive and neural correlates of swing voting

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I, Emmanuel Mahieux, confirm that the work presented in my thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

Publications Statement

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Abstract

Swing voters are crucial to the health of democracies. Thanks to them, political parties and leaders in power alternate. This thesis addresses the question of whether swing voters present distinct psychological, cognitive and neurological characteristics compared to other voters. Its primary contribution to the literature is to show that what sets swing voters apart is differences in adherence to social attitudes known as authoritarianism rather than cognitive or neural differences. The first study explored whether swing voters present distinct psychological characteristics using a large dataset containing political, demographic and psychological variables. It looked at voters who switched parties between the 2010 and 2015 UK general elections, with a focus on those who switched from the mainstream parties to UKIP. Results indicated that these voters were more authoritarian and had lower trust in MPs and that models with psychological predictors were better at predicting switching behaviour than those with demographic predictors. This echoes findings of the importance of authoritarianism as a predictor in recent US and UK elections, which could be specific to the recent electoral dynamics that have focused on forms of "cultural threat" salient to authoritarian values. The second study tested whether swing voters change their mind because of a greater ability to reflect on one's own decisions and mistakes known as metacognition. It experimentally tested whether vote switchers have a distinct cognitive style from other voters marked by lower levels of confirmation bias, a bias which is known to cement voters in their political beliefs. It compared 2016 Trump voters who switched to Biden in 2020 and voters who voted Trump at both elections. Results indicated that swing voters had similar levels of confirmation bias and metacognitive ability as other voters. What set them apart was their lower levels of authoritarianism compared to voters who stuck with Trump. The third study tested whether swing voters' brains showed distinct patterns of neural activity. It employed an implicit neural measure of personal preference -the N400 event-

related potential- of undecided and decided voters before the 2022 mid-term elections in Texas. The study compared the predictive ability of implicit measures of political preference to that of explicit measures in predicting voting choice. It found that swing voters presented similar neural patterns to those of decided Democratic voters although explicit measures of political preference and authoritarianism accounted for more variance in voting behaviour.

Impact statement

In recent years, democratic societies across the world have experienced increases in political polarisation, particularly in countries like the United States. The consequence of such polarisation is that individuals often tend to vote on the basis of their partisan affiliation and become closed to dialogue and to embracing new ideas. This, in turn, makes them less open to changing their mind on who to vote for at elections. For democracies to function well, the electorate must contain a sizable proportion of voters who are open to changing the way they vote as this is the main process through which parties in power alternate, ensuring that politicians with a poor track record get voted out of office. Such voters are usually referred to as swing voters.

One way of addressing this challenge is to understand the individual-level, psychological and cognitive factors that allow people to change their minds about politics and, ultimately, to change their voting behaviour. An understanding of what these factors are would put educators – in the context of school classes on civic education or politics- and policy-makers in a better position to adopt approaches and policies that cultivate their development.

The research undertaken in this thesis contributes to our understanding of these factors. It identifies some of the psychological and personality traits specific to swing voters. It tests for differences in cognition and information processing between swing voters and other voters. Some of these tests showed no difference, which is equally useful because it narrows down the number and types of cognitive processes that possibly underlie swing voting behaviour. When we find no difference between swing voters and other voters, we direct future research to other, more promising avenues.

In a time of polarisation, understanding the traits that foster belief updating and behaviour change is paramount if these traits are to be promoted or cultivated.

Moreover, this thesis provides a warning which can be impactful by contributing to current societal debates. We found that a measure of personality (authoritarianism) originally developed to explain the swing of European societies to the far-right in the 1920s and 1930s has consistently predicted vote switching to the far-right and populist right in our studies, suggesting that similar causes may be at play. Similar causes should be prevented from generating similar effects and we aim to disseminate this warning through an op-ed which will be pitched to non-academic newspapers.

This thesis' inside-academia impact will also be achieved through publication of its component chapters in academic journals. At the time of submission, chapter 3 had just been resubmitted to Scientific Reports, a Nature publication, following an invitation to revise and resubmit by the reviewers. Chapter 2 is formatted and ready for submission to Political Psychology, the leading journal in the field.

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Table of Contents

Introduction

This is a thesis about swing voters: who they are, which psychological characteristics set them apart from other voters and how to predict their vote.

I became interested in swing voters while working as a fundraiser for the Remain campaign during the 2016 EU referendum in the UK. In the months that preceded the referendum, the Remain campaign strove to convince voters that it was better for the UK to remain a member state of the European Union (EU), which it had been since 1972, than to leave it. Unlike US elections where billions of dollars are raised and spent (Federal Election Commission, 2021), the Remain campaign's regulated spend was capped. This meant that we had limited resources to reach out to voters and had to be careful on how to spend them. Although I was involved in raising funds rather than spending them, I had a sense of how they were being used through work meetings and conversations with colleagues. The key point seemed to be targeting specific groups of voters rather than sending out mass emails indiscriminately, which the Leave campaign was thought to be doing. The latter approach was referred to as "spraying and praying" that the message would land with the right voters and have the desired persuasive effect.

Instead, the Remain campaign was using resources in a targeted manner. This involved reaching out to groups who were known to be generally supportive of Remain but were less likely to be registered and to turn out to vote. It also involved reaching out to voters who were still hesitating on how to vote. These voters are typically referred to as swing voters because they can "swing" either way in an election and were particularly important in the

2016 referendum. “Swing voter” also refers to voters who change their mind on who to vote and switch their vote between elections. During the referendum, the largest political parties were split on the issue of EU membership and voters were not able to rely on party cues as they normally would have done in a general election.

Ultimately, Leave won with 51.89% of the vote. The vote cut across party lines: 35% of Leave voters had voted Labour at the previous general election and 61% voted Conservative (Yougov, 2016). It appeared that some voters, especially swing voters, had acted differently than we expected. It also suggested that some of the campaign’s approaches to convince these voters had not worked. Understanding what had happened, how swing voters thought and how to win them over spurred my curiosity and was one of the driving motivations to undertake the research that resulted in this thesis.

My initial search revealed that swing voters had been notably under-studied in the political psychology and political science literature. To illustrate this point, the Oxford Handbook of American elections only contains two mentions of “swing voter” and none of “undecided voter” while the Oxford Handbook of Political Psychology refers to two studies on “undecided voters” and contains no mention of “swing voters”. The present thesis seeks to address this gap in the literature.

Why are swing voters important?

The fact that swing voter psychology constitutes a gap in the literature is all the more surprising because swing voters are arguably one of the most important groups of voters for the health of democracies. The reason for this is that democratic systems rely on the

alternance of parties and leaders in power to prevent any single party or leader from usurping their authority. For parties in power to alternate, there need to be electoral swings. Electoral swings can occur in three ways: differences in how many partisans turn out for each party, demographic changes resulting in new voters joining the electorate and older ones leaving it, or voters changing their minds between elections. The main driver of electoral swings around the world is voters changing their minds rather than the other two (Mellon, 2021).

This fact has been somewhat obscured by recent US elections, which constitute an atypic case in terms of swing voting. In recent years, the proportion of swing voters in the US electorate has fallen to its lowest level ever (Smidt, 2017), which scholars have attributed to the polarization of American politics and society (Smidt, 2017). Some scholarship even found that swings in voting intention in the run-up to the 2012 US presidential election were mostly sample artifacts and that real swings were quite small (Gelman et al., 2016). This is a significant departure from American political tradition where not only voting intention but also partisan identities could fluctuate in the course of an election campaign (Allsop et al., 1988). Undecided voters and independents were traditionally more likely to change their voting intention following campaign events like debates and party conventions, resulting in aggregate changes that could swing an election, like the 2000 contest between Al Gore and George W. Bush (Sunshine Hillygus et al., 2003).

As a considerable amount of political science and political psychology research uses US samples, this appears to have led to the belief that swing voters do not matter as much in elections as differential partisan turnout in the electorate (Osborn et al., 2010; Campbell, 1960; Hill 2017; Hall et al., 2018). Moreover, the majority of studies that break down the components of electoral volatility used data from US elections, further reinforcing this notion

(Key, 1966; Campbell, 1960; Speck et al., 1970; Shively, 1992; Lupia, 2010; Hill, 2017; Hill et al., 2021; Boyd, 1985).

However, Mellon found that in a dataset of 103 inter-election panel studies spanning 18 countries, voters switching parties contributed "three times as much to aggregate volatility as turnout switching on average" (Mellon, 2021, p. 1) and that party switching was the most important factor in 96% of inter-election panel studies. Gomez (2015) also found, using a set of 73 elections comprising six West European democracies, that 75% of aggregate volatility was attributable to vote switching, 17% to differences in turnout and 8% to generational replacement. Blais (2004) reported that 1 in 6 voters in a subset of Western democracies typically changed their mind in the month preceding an election, noting that "even on election day, somewhere between 5% and 10% of the voters […] change their mind." Mellon notes that, logically, vote switching contributes doubly to electoral volatility compared to turnout switching as one vote switch adds one vote to a party and removes one vote from another party simultaneously while one non-voter deciding to turnout only adds one vote to a party.

Even in the United States, although the proportion of swing voters in the voting population has fallen, there is still a debate among academics and electoral data scientists regarding the extent to which they matter in deciding who wins the election. Some analyses for example suggested that a large portion of Democratic gains in the 2018 mid-term elections were due to voters switching from Trump in 2016 to the Democratic party in 2018 (Catalist, 2018). Thus, swing voters still decide elections in the vast majority of elections around the world, potentially even in the United States.

The case for studying swing voters is even stronger in the UK. The UK experienced its highest level of electoral volatility in modern history between 2010 and 2017, with 49% of voters switching parties between the 2010 and 2017 general elections. Political scientists have argued that this extreme volatility is due to historical events such as the 2007 financial crisis, Brexit and a sharp rise in immigration which all lead to electoral shocks (British Election Study, 2019). Because of their unprecedented character, electoral shocks make elections harder to predict. This trend is compounded by the fact that variables that were traditionally good predictors of voting intention, like social class, have lost predictive power over the course of the past decades. Understanding the psychological and cognitive characteristics of swing voters at a time of heightened electoral volatility would put us in a better position to understand future electoral trends and voter motivations.

State of knowledge on swing voters

Defining swing voters

Swing voting can be defined in different ways. The first is vote switchers who change their mind on who to vote for between elections and switch their vote from one party to another (e.g. Bakker et al., 2016; Dassonneville, 2012).

The second is undecided voters who haven't made up their mind on who to vote for yet (e.g. Galli, 2017; Friese et al., 2007). These voters may be undecided because they do not pay attention to politics or because they are cross-pressured. Cross-pressured voters have competing political preferences or values that "pressure" them towards different voting

choices. For example, a voter may have left-wing economic values but right-wing social values, leading to indecision in the run-up to an election.

The third is voters ambivalent in their liking of political candidates. In line with this theory, Mayer (2008) used the American National Election Study (ANES) feeling thermometer which asks respondents how favourably or unfavourably they view the candidates from the two main political parties on a scale going from -100 to +100. By subtracting the rating for the Democratic candidate from that of the Republican candidate, he obtained a score of how likely each individual voter was to be a swing voter. He defined those with a score comprised between -15 and +15 to be swing voters, showing that they represented 23% of voters in post-war US elections.

The fourth is voters open to changing their mind and their vote, or weakly supporting one candidate. This is the approach adopted by Gallup, one of the main pollsters in the US, which gauges voters' openness to changing their mind and the strength of their support for their preferred candidate with two questions: "Are you pretty certain now how you will vote this fall, or do you think you may change your mind between now and the election in November?" and "Do you support [preferred presidential candidate] strongly or only moderately?" (Jones, 2008).

The fifth, in line with classical economic theory, identified swing voters as moderates in the middle of the political spectrum. In a seminal study, Downs (1957) argued that if voters are normally distributed along the ideological spectrum, then political parties will benefit the most from appealing to the "median voters" who harbour moderate attitudes and, hypothetically, form the largest bloc.

I do not equate political independents (non-partisans) and swing voters because this definition would exclude partisans who defect from their party. It is tempting to equate independents with swing voters because swing voters are normally thought of as individuals without strong commitments to political parties, open to voting for more than one of them. Independents, or non-affiliated voters, match this description. However, in recent American history, although the number of independents has grown, many individuals who identify or register as independents are in fact hidden partisans (Mayer, 2005) who "embrace the independent label and the resonance of civic virtue associated with it, but whose actual attitudes and voting behavior are every bit as partisan as those who embrace party labels more openly" (p. 10). Thus, independents can be swing voters but being an independent, non-affiliated voter is not a necessary condition for being a swing voter.

Swing voters do not form a homogeneous socio-demographic group

There is consistent evidence that swing voters do not fall into specific socio-demographic categories and that socio-demographic variables such as sex, age, education and economic situation do not account for swing voting behaviour.

Dassonneville (2012) and Bakker et al. (2016) found that women weren't more likely to switch parties than men. Dassonneville (2012) noted that age had no effect on inter-election volatility in regional elections in Belgium in 2009 although older voters were less likely to switch party within the same election. McAllister (2002) and Crow (2005) found no effect of education on the level of electoral volatility in the US and Mexico. Gidron et al. (2019) showed that changes in material circumstances caused by the 2007 financial crisis and

subsequent economic recession did not lead to electoral swings to far-right parties in the Netherlands although worsening economic conditions are sometimes proposed as a cause behind electoral shifts towards far-right parties (de Bromhead et al., 2013; Funke et al., 2015). Bakker et al. (2016) showed that age decreased the likelihood of switching parties and also found some significant effects of education and household income on switching although these were not consistent across their Danish and British samples. Dimock et al. (2005) noted that in the 2004 US presidential election swing voters as a group tended to have lower educational attainment and lower incomes compared to committed voters. However, it is unclear whether these differences were statistically significant and, as the authors conceded, the socio-demographic profile of swing voters did not differ from that of decided voters in any other regard.

Mayer (2008) selected 10 American socio-demographic groups (e.g. men, women, whites, African-Americans, …) who were routinely reported by the media and political pundits to be significant swing groups in US elections. He compared the proportion of each group among swing voters and among nonswing voters to see if any was more likely to have swing voters than other groups. No group consistently presented a statistically significant difference between the two proportions with the exception of Catholic voters. This is interesting as media accounts of electoral campaigns and outcomes tend to assign electoral shifts to specific socio-demographic groups with little theoretical or empirical grounding. Indeed, attempts to match swing voters to specific socio-demographic categories have resulted in creative categories. In James E. Campbell's (2005, p. 119) words, "efforts to tag the elusive swing voters labeled them as Reagan Democrats, angry white men, soccer moms, NASCAR dads, security moms and […] mortgage moms." The only socio-demographic trait which seems to

be reliably associated with the likelihood of being a swing voter is age, with most studies finding that older voters being less likely to switch parties.

Behavioural traits of swing voters

Looking at the behavioural traits of swing voters has yielded more interesting insights than socio-demographic variables. Key findings are that swing voters tend to have lower political interest, information, attention and engagement than committed voters. Converse (1960) argued that "floating voters," whose voting intentions fluctuate over the course of an election campaign, are likely to be less attentive to campaign dynamics and less partisan than decided voters. Kelley (1983), who refers to them as "marginal voters", noted that in the US presidential elections of 1964 and 1972, they were "on average less well educated, less active politically, less interested in the campaign, less informed, and less attentive to politics." (p. 157) Dimock et al. (2005) confirmed these findings with more recent electoral data showing that swing voters paid less attention to key candidate policy proposals than committed voters and had lower information about the candidates in the 2004 US presidential election. Shaw (2005) noted the same pattern in American swing voters adding that they tend to be less politically involved and motivated. Dassonneville (2012) also found that political interest is a key predictor of switching. Having greater political interest made voters more likely to switch between elections but less likely to switch during an electoral campaign. Those with low interest are more likely to switch during an electoral campaign.

Vote switching, however, is not necessarily reflective of voter disengagement. Although Dutch voters with lower levels of education were more likely to switch between dissimilar parties, van der Meer et al. (2015) found that voters with average educational levels were also

likely to switch, albeit between ideologically similar parties. In this perspective, vote switching can be interpreted as a sign of "voter emancipation" rather than of voter disengagement and apathy. In the authors' words, voters can be "emancipated" from partisan loyalty: "picky voters are loyal to their own ideas, not to a single political party" (p. 110). Having a large number of parties or candidates to pick from is a condition for this situation to materialise. In fact, the supply and number of political parties is a predictor of the probability of switching parties (Dassonneville et al., 2015). The reason is that voters often switch parties to express dissatisfaction with the party they previously voted for. The ability to voice discontent at the ballot box and hold the party they previously voted for accountable depends on the existence of viable options to that party, which tends to be more a feature of multi-party systems like Belgium and the Netherlands.

Moreover, swing voting is not a phenomenon limited to voters with low political interest and no political partisanship. Mayer (2008) noted that the modal swing voter in ANES surveys between 1972 and 2004 was a weak partisan rather than a "pure independent" with no partisan affiliation or leaning. This suggests that swing voters are not solely individuals who fall perfectly in the middle of the ideological spectrum or do not care about politics (given overall low political interest among swing voters). In fact, De Vet et al. (2019) showed that even political party members -with high political interest and information- can become swing voters too, using samples of Flemish and British party members from 2012 to 2015.

Swing voters' vote choices tends to be more influenced by economic issues compared to other voters. Focusing on the 2005 UK general election, Kosmidis et al. (2009) found that the largest determinant of voting behaviour for undecided voters was the government's economic performance. This was a more important factor than liking of the party leaders or campaign-

specific issues like attitudes towards the Iraq war. In this study, undecided voters did not differ from decided voters in how they appraised party leaders. Zaller (2004) reached a similar conclusion with a sample of American voters in 2004, finding that economic issues contributed the most to the determination of floating voters' choice.

However, the evidence in favour of this thesis is mixed, with some research suggesting that swing voters do not differ fundamentally from other voters in terms of the political factors that influence their voting choices. In a panel study of British voters between the 1992 and 2010 general elections, Dassonneville (2016) compared the relative importance of different factors in determining the vote choices of decided voters and of swing voters, whom she refers to respectively as "stable" and "volatile" voters. These factors included political issues salient during the electoral campaign, approval of party leaders, partisan identity and socio-demographic variables. Despite weak evidence suggesting that economic issues were relatively more important for volatile voters than for stable voters, she concludes that "for volatile voters […], there is not a single factor that dominates the vote choice process" (p. 287), contrary to stable voters for whom partisan identity was the dominant factor. A wide array of factors were of similar importance in shaping the vote choice of volatile voters and considerations on the economy were not predominant. What these findings suggest is that there isn't a unifying political factor or type of issue that applies to swing voters specifically and sets them apart from other voters.

Attitude change typically underpins vote switchers' choice. In other words, voters often switch their vote because they come to oppose a party they had previously voted for or because they come to prefer another. Vote switching can also occur if a voter's priorities, rather than their attitudes, change in the course of a campaign. For example, voters who

intended to vote for a party because of their partisan affiliation might switch to another because they prefer another party's candidate and decide that candidate-voting is more important than partisan-voting. Blumenstiel et al. (2014) showed that this phenomenon can occur in the course of an electoral campaign and partially explained short-term electoral volatility in the run-up to the 2009 German federal election.

However, the reverse can also occur, with switching behaviour leading to attitude change. In other words, the act of changing one's political behaviour (voting) can also lead voters to change their political attitudes and beliefs. Schonfeld et al. (2019) found that previously committed UK voters became swing voters in order to remain consistent with their political preferences. They showed this by looking at Conservative voters who voted to remain in the European Union (EU) in the 2016 referendum on Britain's membership in the EU. When the Conservative party changed its policy from remaining in the EU to leaving it in the immediate aftermath of the referendum, these voters switched to other parties at the following UK general election. At the same time, non-Conservative voters who were Euroskeptic and voted to leave the EU at the referendum switched to the Conservative party. Not only did they change their voting behaviour to vote Conservative, they also realigned their political attitudes with the Conservative party's stance on those issues, on economic redistribution for example. In other words, one policy preference -Brexit- led these voters to change party but this party change in turn led them to change another policy preference -economic and redistributive policy. As the authors commented, this could be due to voters' desire to avoid cognitive dissonance, which is the psychological need to be consistent in one's behavior and beliefs (Festinger, 1957). After casting their vote for the Conservative party, these voters may have felt the need to be consistent with their voting choice by aligning their policy preferences with the Conservative party's.

The information-seeking profile of swing voters is mixed. Yasseri et al. (2016) describe voters as "cognitive misers" who seek political information only when considering switching to another party, suggesting that swing voters are active information-seekers. The authors showed that political parties whose Wikipedia pages received more views before the 2009 and 2014 European elections tended to attract more swing voters in the five largest EU countries and that this was particularly the case for new political parties.

Some research has investigated why undecided voters take so long to make up their mind on who to vote for, showing that in the Netherlands, for example, one third of voters made up their mind in the last few days preceding the 2006 general election, with 12% deciding on the day itself (Van Der Kolk et al., 2007). One explanation has been that undecided voters are seeking specific information to make up their mind but do not receive it until the very end of an election campaign. Irwin et al. (2008) offer evidence suggesting a different dynamic: that undecided voters are not missing any information on the parties and candidates. Instead, they "may be waiting until they have finalized their expectations of how others will vote and what the election outcome will be as well as what impact this will have on the governmental coalition the parties may form" (p. 490). This interpretation suggests that swing voters are highly sensitive to what other voters think and make up their minds in response to it, pointing to the importance of group norms rather than information-seeking in shaping undecided voters' decisions.

Although the literature suggests that, overall, swing voters have lower interest in elections and political campaigns, some research indicates that swing voters are more susceptible to campaign effects than other voters. Chaffee et al. (1996) argued that US voters who decide at

the last minute are more open in attempts at persuasion. This is particularly observable in countries like Canada where up to half of the electorate decides their vote choice during the electoral campaign and where campaign events such as party leaders' debates and media coverage affect undecided voters' decisions more than other voters'(Fournier et al., 2004). Fournier (2004) interprets electoral volatility as a sign of undecided voters responding to campaign events rather than random fluctuations in opinion. This contrasts with other analyses which find that the choices of late deciders in US and UK elections appear to be random (Gopoian et al., 1994; Hayes et al., 1996).

There is no clear pattern concerning the risk-taking profile of swing voters and whether it is significantly different from that of other voters. Researchers of American politics have used the likelihood of voting for a challenger candidate rather than for the incumbent as a proxy for risk-taking, as voters who are more risk-taking are more likely to vote for challengers (Eckles et al., 2013). Swing voters appear to have similar risk-taking profiles compared to other voters as they typically do not favour either the challenger or the incumbent. Although several polling analyses (e.g. Bowers, 2004) found that swing voters broke mainly for the challenger candidate in US presidential elections, their findings seem to be due to methodological artifacts (Shaw, 2005). They compare aggregate poll results to the actual vote and attribute the discrepancy between them to undecided voters' vote. However, this discrepancy is also partly due to polling error and unexpected differences in the turnout of decided voters. Using ANES data from 1948 to 2004, Shaw (2005) investigated whether individual undecided voters ended up voting for the incumbent or the challenger. He found that in races with an incumbent president seeking re-election, only 42% of swing voters voted for the challenger against 48% for the incumbent.

Group values

Beyond political interest and engagement, another useful lens to look at swing voting has been through group values. Studies have found that demographic variables have no additional explanatory power once values and personality traits have been taken into account (Caprara et al., 2008), underlining the importance of the latter two. More recent scholarship noted how major electoral realignments such as the Brexit vote split the electorate along value lines and group identities primarily rather than along economic, class or regional divides (Kaufmann, 2016).

Social norms and values are helpful because they are antecedent to political attitudes and guide them, allowing us to identify clusters of voters beyond partisan identities and voting intentions. Turner et al. (2018) and Surridge et al. (2018), for example, categorised British voters into ten categories that cut across the left-right political divide, basing these categories on a combination of social and economic values. Each of these categories constituted a "moral clan". This framework showed that the majority of vote switchers at the 2017 general election fell in the moral clans referred to as the "Proud and Patriotic State" and the "Modern Working Life". Members of the "Proud and Patriotic State" clan support redistributive policies and oppose multiculturalism and freedom of movement. Because the "Proud and Patriotic State" clan members had been the most likely to vote for UKIP, many of its voters switched to the main parties in 2017 when UKIP collapsed. Members of the "Modern Working Life" clan, on the other hand, believe in individual responsibility and initiative and hold socially liberal views. About 1 in 10 of its members switched between Labour and the Conservatives in 2017 and their values stand at the mid-point compared to those of the other moral clans. Because of this, they are electorally important as both Labour and the

Conservatives can win their vote. The authors argued that moral clans are useful predictors of political behaviour at times of electoral volatility because group values are guiding principles of behaviour and tap into more fundamental processes than voting intention.

The case of the "Modern Working Life" clan voters is of particular interest because these voters are cross-pressured by their economic values – which are more aligned with the Conservatives- and their liberal social values -which are more aligned with Labour. This underlines an important point: swing voters are not only voters with low political information and without political or group loyalties. They can also be voters who are cross-pressured by conflicting individual values, group identities and social networks.

In fact, conflicting economic and social values account for recent voting and switching patterns. Bale et al. (2020) showed that in the UK, 2017 Labour voters who switched to the Conservatives in 2019 held left-wing economic values but social values that were more conservative than those of other Conservative voters. Labour MPs and party members, on the other hand, held social values that were considerably more liberal than their own voters' and than the general electorate's. The authors suggested that Labour-to-Conservative switchers were cross-pressured between their economic and social values although the latter were ultimately determinant in swinging their vote.

Social norms

Social norms are socially determined standards that indicate what behaviors are considered typical or proper in a given context. They play an important role in maintaining certain behaviours. Questioning or rejecting social norms can lead to major societal changes. Social

norms can change through a process of social imitation. Eyster et al. (2010) theorised that individuals can adopt new ideas simply because they see others adopting them, a process they refer to as "naïve herding". This process can occur when people realise they are in the minority and feel the social pressure to conform to the norm.

In fact, social norms can exert a major influence on individual political attitudes. Pattie et al. (2000) showed that the more voters had conversations with close friends and relatives holding different political views, the more likely they were to switch their vote. This suggested that individuals became swing voters when discovering that their views were in the minority in their in-group of friends and relatives, leading them to change their mind to conform to their in-group norm.

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Thus, the political science literature has produced heteroclite and oftentimes contradictory insights into swing voting, with few consistent patterns emerging. Swing voters have low political interest, information and engagement but are also more sensitive to campaign effects (Kelley, 1983; Dimock et al., 2005; Shaw, 2005; Dassonneville, 2012). They are believed to be politically disengaged but vote switching can also reflect voter emancipation, with educational attainment possibly mediating this relationship (van der Meer et al., 2015). Swing voters appear to be more concerned with economic issues than other voters but no specific issue is predominant in determining their vote choice (Kosmidis et al., 2009; Zaller, 2004; Dassonneville, 2016). They appear to be sensitive to what their in-group and the broader electorate think and vote, leading to vote switching and political preference realignments (Irwin et al., 2008; Pattie et al., 2000). They do not form homogeneous socio-demographic

groups and no socio-demographic variable is consistently associated with swing voting. Age was the only exception, with older voters being less likely to switch party than younger voters (Dassonneville, 2012; Bakker et al., 2016). So far, the literature has not produced a unified and consistent account of the characteristics of swing voters and of what differentiates them from other voters.

A recurrent theme raised by the researchers reviewed above is that the aggregate data used for their analyses often do not allow them to investigate the individual motivations of swing voters and the individual-level determinants of their vote choice (e.g. Mellon, 2021). Our understanding of these motivations and determinants would benefit from experimental approaches testing the cognitive and psychological specificities of swing voters, something that political science studies of swing voting have not attempted. We contend that psychological factors have a greater potential to account for the behaviour of swing voters than socio-demographic factors and the variables employed in the political science analyses of swing voting. In Shaw's (2005) words, we "believe that individual psychological factors are significantly more important for explaining swing voting than being a member of a particular group" (p. 76).

Approaches to studying swing voters

Scholars of political behaviour face a major methodological challenge when attempting the study of swing voters: they are by definition undecided, wavering in or unaware of their voting intentions. Their explicit preferences -which are the tools that scholars and pollsters normally use to predict voter behaviour- are either uncertain or unknown. This limits the ability of such measures to predict their voting behaviour as swing voters' preferences may

vary through the course of an electoral campaign and swing voters themselves may not be fully aware of their own preferences.

Swing voters' vote recall constitutes another methodological challenge (Mellon, 2021). The ability to recall one's vote from past elections declines with time (Weir, 1975; MacDermid, 1989; Van Elsas et al., 2014; Van Elsas et al., 2016). Vote switchers tend to have particularly low recall accuracy, with Dassonneville et al. (2017) finding that about 30% of vote switchers in Germany and Belgium do not correctly recall which party they voted for in the previous election. This stresses the need to use panel data, where respondents are asked which party they voted for soon after they cast their vote to mitigate the issue of inaccurate vote recall.

Shaw (2005) argued that psychological predispositions and sociopolitical identities are prior to issue positions, making them more useful explanatory variables than explicit preferences on political issues. This applies particularly to swing voters who tend to have low political interest and information, so who may not have defined issue positions.

Different approaches in political psychology can be profitably applied to the study of such psychological predispositions in swing voters. I review them here in succession.

Personality approaches

A fertile vein of research in political psychology has used personality traits to account for several aspects of voting behaviour and political attitudes. Personality traits are defined as the basic dispositions that predispose one to consistent patterns of thought, feeling and action (McCrae and Costa, 2008). Although recent work by Bakker et al. (2021) questions the

causal relationship between personality and political attitudes, personality traits have traditionally been assumed to be causally antecedent to the other structures of personality such as beliefs about oneself, values and social attitudes, making them a key factor in explaining differences in the ways personalities manifest themselves, including political manifestations.

The Big 5 Personality traits (John & Srivastava, 1999) are the metric of personality most often used. These traits are Openness to new experience, Conscientiousness, Extraversion, Agreeableness and Neuroticism and are often abbreviated as OCEAN. I borrow the following definitions from the Oxford Handbook of Political Psychology (Caprara et al., 2013, p. 31). Openness to experience "refers to an interest in culture and curiosity about new experiences", with individuals high in openness thought to be innovative, imaginative, and creative. Conscientiousness "refers to individuals' tendency to pursue order and meet one's own obligations" with individuals high in conscientiousness referred to as diligent, reliable, and precise. Extraversion "refers to individuals' tendency to behave and react vigorously in different situations" with individuals high in extraversion said to be dynamic, active, and sociable. Agreeableness "refers to individuals' concern for altruism, generosity, and loyalty" with individuals high in agreeableness usually characterised as kind, honest, and sincere. Neuroticism, the opposite of Emotional stability, "refers to the control of impulses and emotions". Individuals low in neuroticism are described as calm, patient, and relaxed. The Big 5 are "the most widely accepted model to address differences in behaviour in manifold contexts" (Caprara et al., 2013, p. 31), including political contexts (Mondak, 2010). Scholars have shown a variety of associations between Big 5 personality traits and political attitudes.

The most replicated of these associations are between openness to experience and left-wing voting and liberalism and between conscientiousness and right-wing voting and conservativism. In other words, individuals high in openness to experience tend to prefer left-wing parties and candidates while individuals high in conscientiousness tend to prefer right-wing parties and candidates. This association has been replicated across countries including the United States (Barbaranelli et al., 2007), Poland, Belgium (Van Hiel et al., 2000), Germany (Riemann et al., 1993) and Italy (Caprara et al., 2006). The relationship between openness and left-wing preferences is greater in magnitude than the relationship between conscientiousness and right-wing preferences. The theoretical links posited between these are that conscientiousness expresses a desire for order and convention while openness to experience reflects more open-minded, creative and novelty-seeking mindsets. This phenomenon is also observed at the aggregate level: Republican states in the US had higher levels of conscientiousness and lower levels of openness than Democratic states (Rentfrow et al., 2009). The links between the other three personality traits -Extraversion, Agreeableness, Neuroticism- and political attitudes is less evident and does not replicate consistently across countries and contexts.

Moreover, not only do personality traits correlate with voting behaviour and political attitudes, they also have significant correlations with various forms of political participation. Studies have found that personality traits were related to political activities. For example, openness to new experience was related to speaking at meetings on local political issues, extraversion to attending campaign rallies and agreeableness to signing petitions regarding local political issues (Mondak et al., 2008).

The personality approach to studying political attitudes and electoral behaviours offers the potential to explain additional variance beyond that explained by traditional socio-demographic variables. Socio-demographic indicators such as age, gender, education and income account for a maximum of approximately 10% of variance in ideological self-placement. Personality traits account for 5 to 20% of variance (Caprara et al., 2013).

This approach has already borne fruit in the study of swing voting. Bakker et al. (2016) looked at the personality traits of voters who switched parties in the UK and Denmark, finding that they tended to have high openness to experience and low extraversion. The authors suggested that higher openness to experience might make these voters able to consider alternatives more than other voters, including alternative ways in which their country or society could be governed, making them more likely to switch their vote to another party. They also speculated that switchers' low extraversion might indicate that they tend to engage less with others, especially in political conversations that have a higher risk of being acrimonious. Extroverts, on the other hand, are more likely to engage in political activity (Mondak et al., 2010), to discuss politics (Hibbing et al., 2011) and to identify as partisans (Gerber et al., 2012).

A considerable amount of scholarship has been conducted on the assumption of the relationship between personality traits and political attitudes, with the former shown to causally influence the latter. Although small, this relationship was believed to be robust. Recent scholarship has questioned its robustness, with Fasching et al. (2023) finding that childhood personality traits related to negativity bias are only weakly and inconsistently associated with different forms of conservative political attitudes. Moreover, Bakker et al. (2021) found evidence suggesting that the reverse might also be at work, with political

preferences exerting causal influence on self-reported personality traits. These recent strands of research stress the need to further investigate the link between personality traits and different political attitudes and behaviours, such as swing voting, in different samples.

Personality approaches thus offer promising insights into the psychological characteristics of swing voters and vote switchers but this potential remains largely untapped and warrants further research.

Confirmation bias

A major psychological influence on attitudes and decision-making, including in the political sphere, is confirmation bias. Confirmation bias is the tendency to embrace information that confirms our beliefs and to reject information that disconfirms them. It is a cognitive process with a long research history. Philosophers already had an intuition of confirmation bias before it was formally demonstrated in an experimental setting. Francis Bacon wrote in 1620 that 'the human understanding when it has once adopted an opinion (either as being the received opinion or as being agreeable to itself) draws all things else to support and agree with it'. Benjamin Franklin formulated a similar idea, noting that rational thinking allows us to find reasons to support any idea we decide to endorse: "so convenient a thing is it to be a rational creature, since it enables us to find or make a reason for everything one has a mind to". Even Dante Alighieri made one of the characters in his Divine Comedy, St. Thomas Aquinas, warn that "Opinion—hasty—often can incline to the wrong side, and then affection for one's own opinion binds, confines the mind", in other words, attachment for our own opinions can prevent us from changing our mind.

Peter Wason (1960) was the first to formally demonstrate the existence of confirmation bias in an experimental setting. He showed that participants tended to enumerate confirmatory evidence supporting their beliefs rather than eliminating their beliefs as they encountered disconfirmatory evidence. However, the experiment required the participation of an in-person experimenter to provide the participants with feedback and subjectively assess if their answers constituted instances of "enumerative" or "eliminative" thinking. This made it difficult to scale up the experiment and reach the necessary sample size to be able to observe intergroup differences in confirmation bias. Moreover, variability in experimenter judgement would make it difficult to compare the scores obtained from different experimenters.

Other operationalisations of confirmation bias followed, with a greater focus on political cognition. In a classic experiment, Lord et al. (1979) showed that participants tended to embrace evidence confirming their prior beliefs on a political issue, leading them to become more polarised on that issue in the course of the experiment. Replications of this experiment presented mixed results on whether beliefs polarised subjects after receiving disconfirmatory evidence (Vallone, 1985; Guess et al., 2020).

Confirmation bias has also been measured by looking at the reaction times when reading confirmatory and disconfirmatory information. Taber and Lodge (2006) and Edwards et al. (1996) adopted this approach, showing that the time spent reading counter-attitudinal arguments was greater than that spent reading arguments supporting one's beliefs. The authors interpreted these results as indicating that information supporting our beliefs is immediately read and agreed with while information we disagree with motivates us to actively refute them, which takes more time. Ditto and Lopez (1992, 1998) reached the same

conclusion, finding that information consistent with a preferred belief is examined less critically than information inconsistent with it.

The expression of confirmation bias in political cognition that has received the most attention is partisan bias, the tendency to embrace information from one's political party, ideology or leader. Partisan bias has been documented in applications ranging from moral judgement, for example in voters' attitudes towards politicians' immoral behaviour (Walter and Redlawsk, 2019), to vote choices at elections (Jessee, 2010; Bartels, 2002) where the inclusion of partisan bias explains how ideological preferences influence voting behaviour. Scholars have formulated the possibility that this form of confirmation bias may be an adaptive behaviour which has been beneficial to humans in the course of evolution. Writing about partisan bias, which he refers to as "my side bias", Stanovich wrote that "some might argue that something so ubiquitous and universal must be grounded in the evolution of our cognitive systems (either as an adaptation or as a by-product)" (Stanovich, 2021, p. 22). He argued that beliefs do not always need to "track the world with maximum accuracy in order for fitness to increase" and that increases in fitness do not necessarily entail increases in rationality. In a parallel with signal detection theory, Stanovich noted that biased beliefs generate more false alarms than accurate ones because of their inferior accuracy in tracking the world. However, this may confer an advantage in survival chances as it allows higher processing speed and the ability not to interrupt other cognitive activities.

Confirmation bias research has been mainly confined to the study of individuals at the extremes of the political spectrum. Scholars have for example shed light upon extreme political partisans' cognitive flexibility (Zmigrod et al. 2018, 2020) while others examined dogmatic and radical individuals' ability to objectively assess their own thought processes

(Rollwage and Fleming, 2018), showing that extreme partisans have lower cognitive flexibility than moderate individuals and that dogmatic and radical individuals have lower metacognitive sensitivity compared to those with moderate beliefs.

At the heart of confirmation bias is the fact that individuals integrate information that confirms their beliefs and discard information that disconfirms them. Another way to phrase this in cognitive science terms is that they do not update their beliefs when receiving disconfirmatory information or that they update their beliefs when receiving confirmatory information, hence becoming more polarised. Measuring whether individuals update their beliefs thus provides a useful operationalisation of confirmation bias. Recent perceptual computational tasks (Rollwage and Fleming, 2018) offer ways of measuring this in an objective, political content-free way. Measuring belief updating in an objective way, without using explicitly political measures is important for two reasons. Past studies of belief updating (Lord et al., 1979; Vallone, 1985; Guess et al., 2020) relied on subjective ratings of attitude change with questionnaires and Likert scales administered before and after the experiment. However, such self-reports are vulnerable to several risks, such as subconscious influences on political attitudes which could lead to different responses in real-world scenarios and acquiescence bias. Using objective measures avoids these risks. Also, we aim to identify "content-free styles of thinking" (Rollwage et al., 2019) characteristic of swing voters. In other words, we would like to identify the specificities in the way swing voters think beyond differences in political attitudes and behaviour. This requires using measures free of political content.

Thus, there is extensive research on the cognitive correlates of extreme political attitudes and behaviours, with evidence suggesting that confirmation bias -or partisan bias- plays a key role

in shaping them by making extreme partisans cognitively inflexible and unable to update their beliefs. However, while there is abundant scholarship on the biases and cognitive processes of voters on both sides of the political spectrum (Ditto et al., 2019) and particularly at its extremes, there is a considerable gap on those of voters in the middle segment, particularly on swing voters. Whether the difference between these two types of voters is due to differences in confirmation bias warrants exploration.

Authoritarianism

Authoritarianism is a personality adaptation which promotes adherence to group norms and submission to leaders above individual autonomy and freedom (Engelhardt et al., 2023).

Its theoretical framework was originally developed to explain the causes behind the rise of Nazism and Fascism in Europe, as scholars (Adorno et al., 1950, Fromm, 1941) sought to understand how entire populations could embrace these ideologies. Seen in this perspective, authoritarianism is the conceptual tool developed to make sense of a swing vote of historical proportions and significance to the far right. Germany experienced such an electoral swing in the period between the federal election of 1924 and the last free and fair election which took place in November 1932. Between these two elections, the national socialist party of German workers, better known as the Nazi party, increased its vote share from 6.55% to 33.09%. In absolute terms, it went from receiving less than a million votes in 1924 to gaining over 11 million in 1932, indicating that over 10 million voters switched to it in eight years.

Authoritarianism is a helpful tool to explain swing voting behaviour not only for historians but also for modern-day political psychologists and scientists seeking to shed light on current political shifts. Stenner and Haidt (2018) found that in situations of high normative threat, the

probability for voters with high authoritarianism scores of voting for a far-right candidate in the US or France was respectively 87% and 84% compared to 7% and 11% for voters with low authoritarianism scores.

The measurement of authoritarian attitudes that was employed to obtain these results has evolved significantly since the original scale. The original scale, Adorno et al.'s (1950) "F-scale", aimed to measure an individual's predisposition to fascism and measured nine traits which, taken together, constituted the authoritarian personality. These included authoritarian aggression, authoritarian submission, conventionalism, anti-intraception (the ability to look inwardly), superstition and stereotypy, destructiveness and cynicism, projectivity (the tendency to see the world as a dangerous place), concerns over deviations from sexual norms, and power and toughness. Adorno et al.'s construct constituted the first systematic study of the personality traits underpinning prejudice (Caprara, 2013).

However, it presented considerable issues: it was psychometrically unreliable (Allport, 1954), prone to acquiescence bias and its assumptions were susceptible to different biases. Critics pointed to the authors' definition of authoritarianism as characteristic of right-wing rather than left-wing ideologies (Eysenck, 1954). Moreover, the authors applied an orthodox interpretation of Freudian psychoanalysis in their interpretation of authoritarian individuals' responses which lacked empirical grounding. As an example, explaining the genesis of authoritarian aggression, Adorno (1947) wrote that "the forbidden action which is converted into aggression is generally homosexual in nature. Through fear of castration, obedience to the father is taken to the extreme of an anticipation of castration in conscious emotional approximation to the nature of a small girl, and actual hatred of the father is suppressed. In

paranoia, this hatred leads to a castration wish as a generalized urge to destruction" (pp. 158-159).

New scales were developed to measure individuals' predisposition to authoritarianism while addressing these concerns. Altemayer (1981) developed a Right-Wing Authoritarianism (RWA) scale which narrowed down the traits underpinning the authoritarian personality from nine to three: authoritarian aggression, authoritarian submission and conventionalism. The RWA scale proved psychometrically reliable. The problem inherent to it is that the wording of its items mimics the rhetoric of right-wing authoritarian politicians. This poses the risk of endogeneity as the independent variable (the RWA score) is too similar to the dependent variable (e.g. political attitudes, voting for far-right parties) it is meant to explain. In other words, it is an attempt to explain political attitudes and behaviours with other political attitudes and behaviors constituting the same phenomenon. It is preferable to use items that are not explicitly political in their content to avoid this possibility.

Karen Stenner developed a scale that addresses this risk. Stenner (2005) and Engelhardt et al. (2023) developed a measure of authoritarianism that constitutes an implicit measure of political preferences. It relies on asking participants which values they consider most important in raising children, for example if it is more desirable for a child to be curious or to have good manners. It is considered an "implicit" measure of political preferences because it measures an attitude that underlies political preferences without being explicitly political and without using explicit agreement or disagreement with political preferences. The advantage of using the child-rearing values scale is that it reliably measures authoritarian attitudes and their political correlates without using wordings that are explicitly political, thus avoiding the

risk of the dependent and independent variables being the same thing, allowing us to test the predictive potential of implicit authoritarian attitudes.

Stenner (2005) described authoritarians as "people [who] will never live comfortably in a modern liberal democracy". In normal times, they are undistinguishable from the rest of the population and most of them vote for mainstream political parties. What makes someone authoritarian is not a specific ideology but a personality predisposition independent of politics to follow leaders and group norms at the expense of personal freedom. This predisposition is activated when they feel a strong cultural threat and perceive the social bonds and norms around them to be unravelling.

Neuro-politics

Non-political psychological paradigms have brought useful conceptual frameworks to the study of political cognition. One of them takes the starting point of the many choices we make on a daily basis. For the vast majority of them, we rely on instant, unconscious judgements. Kahneman showed how such instant judgements are based on what he called "heuristics", cognitive shortcuts that help us make decisions quickly. Heuristics prevent us from getting bogged down in endless deliberations about the pros and cons of each option when we're choosing between sandwiches for lunch or routes to take back home. These heuristics belong to what Kahneman referred to as "System 1" (Kahneman, 2011), a system of decision-making based on fast, automatic, unconscious thinking. He contrasted it with "System 2", a system of thinking and decision-making which is slow, effortful, weighs the pros and cons of each option in a deliberate and thorough manner. Decisions made by System

1 include routine, everyday choices while important life decisions are normally entrusted to System 2.

Instant judgements make us lean towards one option rather than the other(s), making us instantly like one option more than the others. This affective leaning we experience in any given choice is also physiological. Antonio Damasio (1994) formulated the hypothesis -and provided evidence for it- that our body instantly generates signals of approach and avoidance that make us lean towards or away from any given option, reducing the number of options that our conscious deliberation will have to choose from. These signals, known as "somatic markers", express themselves in a variety of ways.

Recent research has explored the role of instant, unconscious judgements and somatic markers in the field of political cognition and decision-making. Tsakiris (2021) explored whether individuals' physiological states influence the traits they look for in political leaders. Participants were shown AI-generated faces of fictional leaders, with the faces reflecting different gradations of dominance and trustworthiness, and were asked if they would vote for them. These faces were shown at the systolic and diasystolic phases of participants' cardiac cycle. The diasystolic phase indicates when the heart relaxes, leading to a decrease in blood pressure while the systolic phase indicates when the heart contracts, leading to an increase in blood pressure. The systolic phase tends to heighten fear emotions more than the diasystolic phase (Garfinkel et al., 2014). Participants were significantly more likely to say that they would vote for more trustworthy and less dominant-looking leaders during their systolic phase, when their physiological sense of fear was heightened. This suggested that somatic markers like our heartbeat and the affective states they elicit can influence our political cognition and decision-making.

These influences should be explored further given their importance although it is methodologically challenging to study instant, unconscious judgements because they constitute a black box. We cannot directly observe or measure the processes occurring in subjects' minds when for example they prefer trustworthy to dominant leaders in situations of heightened fear. One avenue which has been particularly promising in this perspective is the relatively new field of neuro-politics, which applies neuroscientific methods to map political cognition. The reason it is a promising avenue is that it allows us to observe the neural correlates underpinning instant, unconscious judgements and somatic markers.

Neuro-politics offer an exciting way to explore political attitudes and behaviour because neuroscientific methods like functional magnetic resonance imaging (fMRI) and electro-encephalography (EEG) give us information that we would not be able to gain from behavioural measures and this information is often qualitatively different.

Political attitudes have been a frequent object of enquiry for neuroscientists. For example, Kaplan et al. (2007) conducted a study in which they asked registered Republican and Democratic voters to rate the emotions they felt in seeing pictures of US presidential candidates. While they viewed the pictures, their fMRI data were acquired to compare brain activation when viewing one's preferred candidate to brain activation when viewing the opposing candidate. The behavioural data showed the expected pattern: voters reported more negative emotions when viewing the opposing candidate and more positive emotions when viewing their preferred candidate. The fMRI data showed something more: brain regions involved in cognitive control and emotional regulation showed activation. The authors interpreted this as a sign that voters were actively trying to control their negative emotions at

the sight of the candidate of the opposing party. This was made more plausible by the fact that this specific presidential campaign had been characterised by negative campaigning, where voters would have been primed to dislike the opposing candidate rather than to like their own candidate. Insula activation -which is held to be a marker of disgust or distaste- provided supporting evidence to this interpretation. Voters weren't passively experiencing positive emotions for their candidate and negative emotions for the opposing one, but actively controlling their negative emotions for the latter.

A study on US non-partisan voters conducted by Schreiber et al. (2020) is another case in point. The study looked at voters registered as independents and compared them to voters registered as Democrats and Republicans on a risk-taking task during which fMRI data were acquired. The behavioral measures recorded in the task showed no difference between non-partisan and partisan voters. The implicit, neural measures did, showing that non-partisans had higher levels of activation in brain regions involved in maintaining healthy social connections. These activation patterns suggested that non-partisans' brains were more active in trying to understand the emotions felt by others -which could translate, for example, into avoiding acrimonious political discussions by anticipating the hostile feelings that these would create- and in controlling emotional reactions to social exclusion.

Studies using electroencephalography (EEG) have also opened a new vein of neuro-political research which uses event-related potentials (ERPs) to detect individuals' implicit moral and political preferences. EEG consists in the recording of the brain's electrical activity, which is done with electrodes placed on participants' scalp. EEG has excellent temporal resolution, meaning that it measures the exact timing of the brain's response to different events. ERPs

are scalp-recorded, continuous measures of electrical brain activity that provide a window into the unfolding cognitive processes that lead to a behavior.

Several ERP studies have shown the potential of neuroscientific methods in shedding light onto swing voters' political attitudes and decision-making processes. Van Berkum et al. (2003) showed that moral judgements had neural correlates in the form of different ERP waveform patterns, using an ERP known as the N400. Galli et al. (2017, 2021) showed that the same ERP could also reflect the political preferences of voters from opposite political sides or parties. Building on this finding, they tested whether they could map the political preferences of undecided voters who, by definition, claimed not to have any preference or any well-defined preference. Interestingly, although these voters had undefined explicit political preferences, their ERP data suggested that they did hold implicit political preferences which were reflected by their N400 ERP. This measure was also predictive of the way they would vote. The authors also showed that the implicit preferences reflected by the ERP improved the predictive power (in predicting vote choice) of measures of explicit political attitude. In one of these studies, they noted that the ERP of interest reflected differences between voters of opposed parties only for economic issues but not for other political issues.

We would argue that the value of implicit, neural measures of political attitudes and behaviours lies mainly in their ability to detect insights that behavioural measures would miss. The use of implicit measures has been criticised by some (Friese et al., 2012) who compare implicit with explicit measures on the sole basis of their ability to predict voting outcomes. This is an important comparison to make as it helps us understand the relative importance of conscious, explicit preferences and unconscious, implicit preferences on

political behaviour, especially as the evidence on this relative importance is mixed. However, we would argue that this is not the sole benchmark by which to assess implicit measures. These give us insights into the processes shaping political attitudes and decision-making that explicit measures cannot detect. The question should not be solely framed as "Are implicit measures better than explicit measures at predicting voting behaviour?" but as "Do implicit measures tell us something new or different about voting behaviour and political attitudes that explicit measures cannot tell us?"

Given the present gap in the literature, there is little we know about the psychological, cognitive and neural characteristics that set swing voters apart from the rest of the electorate. Neuroscientific methods allow us to map the neural processes that lead to attitude formation or decision-making, offering novel ways to identify the psychological and neural correlates of swing voting.

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Thus, the approaches we adopted to study swing voters were motivated by several reasons. As we discussed, swing voters have uncertain attitudes and preferences that they themselves may not be fully aware of. The political science toolkit relies overwhelmingly on self-reports which may not be entirely reliable measures of swing voter preferences and motivations. The psychological, cognitive and neural measures we employed are better suited to identify the preferences and processes underlying swing voters' decision-making. Identifying swing voters' psychological characteristics and personality traits provides an important first step as there is evidence that they are causally antecedent to and influential for political attitudes, hence providing a better guide to swing voters' uncertain preferences and behaviours.

Authoritarianism was originally designed to account for electoral swings and has proven its usefulness in accounting for swings to the far-right in recent years. We believe that its inclusion may also shed light on specific types of recent switching behaviour.

We believe objective cognitive tasks also provide a useful tool to determine if swing voters present a distinctive "style of thinking" compared to other voters. Political science tools such as political preferences and partisan identity have yielded inconsistent results as to what sets swing voters apart from other voters. Cognitive tasks "scrubbed" of political content allow us to look beyond political science variables to examine whether swing voters think differently compared to others across domains rather than in the sole domain of political cognition.

Using neuroscientific methods allows us to further explore the instant, unconscious judgments that underlie political attitudes and decision-making. This approach is particularly adequate for swing voters as the determinants of their voting decisions remain relatively unknown. Neuroscientific methods allow us to look into the black box of the instant, unconscious processes that may play a major role in swing voter cognition and decision-making, and offer qualitatively different insights compared to the measures used to this day.

There are several promising avenues to examine the distinctive psychological, cognitive and neural correlates of swing voting. We began by exploring whether, at an aggregate level, swing voters presented any distinct psychological traits. For this purpose, we used a large, pre-existing dataset with individual-level data on voting history -to identify swing voters- and psychological and other variables of interest. We adopted an exploratory approach to identify associations between swing voting and a broad array of variables that may underlie it.

Chapter 1 - Psychological correlates of swing voting: do switchers present distinct psychological traits?

Introduction

The last decade has seen dramatic political shifts in the electoral landscape. The Brexit vote and Trump's election were entirely unpredicted outcomes that took pollsters and pundits by surprise (Messina, 2016; Cohn, 2016). These political shifts have been clearly evident in recent UK politics. The 2019 European elections showed the extent to which the electorate has been in flux: Labour and the Conservatives, which have traditionally been the largest forces in British politics, arrived respectively 3rd and 5th, with the newly created Brexit party arriving 1st. A recent paper by the British Electoral Study (BES, 2019) indicated that electoral shocks such as the Brexit vote and the financial crisis have made the British electorate more volatile than ever. The BES found that 50% of British voters in its sample had switched their votes between political parties in the 2010-2017 period. This poses a question: why has the British electorate become so volatile? How could so many people switch their votes from one party to another? Significant events such as the Brexit vote and the financial crisis are important factors at the macro-level but, at the level of the individual voter, what explains why some people switch their vote during these dramatic times, and some do not?

Traditionally, voting behaviour was predicted using socio-demographic variables, ever since George Gallup correctly predicted Franklin D. Roosevelt's victory at the US presidential election of 1936 using a demographically weighted sample of 50,000 respondents (Jones, 2008). Until recently, looking at demographics was a good way of predicting voting behaviour. Social class was a particularly reliable indicator in Britain, with the Conservatives

receiving more votes from middle class voters and Labour from working class voters. However, socio-demographic variables –social class in particular- have become less reliable predictors in recent elections (Curtis, 2019).

In parallel, it is becoming increasingly clear that voting behaviour has various psychological correlates. For example, multiple studies have shown that individuals who are more "open to experience" – one of the Big 5 personality traits (John & Srivastava, 1999) – tend to prefer left-wing parties and ideologies while those who are high in "conscientiousness" tend to be more right-wing and conservative (Barbaranelli, Caprara, Vecchione & Fraley, 2007, Carney, Jost, Gosling & Potter, 2008). Ekstrom and Federico (2017), for example, found that three of the Big-5 personality traits, namely openness, conscientiousness and agreeableness, predicted changes in attitudes held by US voters towards presidential candidates in the course of the 2008 US electoral campaign, with openness and agreeableness predicting higher support for Barack Obama and conscientiousness predicting higher support for John McCain.

Some scholars have suggested that psychological traits are better predictors of political behaviour than socio-demographic traits. For example, Caprara and Vecchione (2013) looked at whether traditional socio-demographic indicators or psychological indicators explain differences in ideological self-placement, in other words, in how individuals identify politically. They found that within the US and European countries, Big Five personality traits accounted for between 5% to 20% of the variance in voters' ideological self-placement. In contrast, basic socio-demographic variables such as gender, age, income and educational level, did not account for more than 10% (Caprara & Vecchione, 2013).

The term “predicting” requires an explanation. “Predicting the vote” can refer either to predicting individual voting decisions or to predicting aggregate voting outcomes. “Predicting” in this article refers to the way each individual votes, and our aim is to generalise our predictions from individual cases to the broader population. However, it is important to caveat that this study relies on a sample of the voting population, inviting caution when trying to generalise findings.

Moral psychologists like Jonathan Haidt argue that, to understand differences in political behaviour, one needs to look at voters’ moral foundations as these underpin their political ideas and voting motivations (Etkin & Haidt, 2016). Haidt showed that moral foundations (underlying moral values) such as care and fairness were relatively accurate predictors of whether US primary voters would support certain candidates in 2016. Moral foundations theory has also been found to predict individual attitudes on a range of politically salient topics from vaccine hesitancy to climate change. Amin, Bednarczyk, Ray, Melchiori, Graham, Huntsinger and Omer (2017) found that parents who place higher importance than others on liberty and purity are more likely to hesitate as to whether they should vaccinate their children or not. In other words, these moral foundations predict whether parents hesitate to vaccinate their children, with high-hesitancy parents twice as likely to strongly emphasize purity and liberty compared to medium-hesitancy parents. Dickinson, McLeod, Bloomfield and Allred (2016) use the Cornell National Social Survey to show that compassion and fairness were strong, positive predictors of the willingness to act on climate change in the US population. Looking at newspaper op-eds and public-service announcements in the US, Feinberg and Willer (2012) found that contemporary environmental discourse is based largely on concerns related to the moral foundations of harm and care, which also explain differences between conservatives and liberals on environmental issues. These different

findings highlight the importance of moral psychological traits in shaping political beliefs and behaviours.

Others have stressed the importance of psychological factors in shaping individual voting decisions in recent elections. Kaufman (2017) argues that attitudes were a better predictor of the Brexit vote than socio-economic variables or education level. Using a BES Internet Panel of over 24,000 respondents, he noted that measures of authoritarian attitudes such as support for the death penalty were effective predictors of the Brexit vote and other political attitudes, with 71% of those most in favour of the death penalty indicating in 2015 that they would vote to leave the EU. This finding was reinforced by a subsequent analysis by Lewis and de-Wit (2019) which found that authoritarian attitudes were one of the most defining features of subgroups of the UK population with anti-EU attitudes. Mayer, Berning and Johann (2020) also explored the role of psychological factors in voting decisions although they focus on narcissistic rivalry, finding that it accounts for radical right support in Germany, in the context of the rise of far-right party Alternative for Germany. These different strands of research suggest that psychological factors such as authoritarian attitudes underlie extreme political behaviours like the Brexit vote and support for far-right parties.

A leading pollster's experience further illustrates the importance of taking into account psychological factors when predicting voting behaviour rather than solely relying on socio-demographic variables. A pollster who worked on the 2016 EU referendum –speaking under Chatham House rules- reflected on the reasons why his polling company mispredicted the outcome of the referendum, believing that Remain would win. His company didn't think that poor voters in Northern England would turn out to vote for Leave, although these respondents said there was a 10/10 likelihood that they would do so. They did not believe these

respondents as their data showed that people in these socio-demographic categories (low-income, Northern English) had a record of very low turnout. This error shows the shortcomings of relying solely on socio-demographic traits when predicting electoral outcomes. It suggests that greater attention should be paid to voters' motivations. This explains the present article's interest in voters' psychological traits to predict their political behaviour.

It is striking that, in light of these recent findings and developments, polling agencies and political operatives still seem to rely overwhelmingly on socio-demographic variables in predicting vote choices without considering the psychological traits that motivate people to vote. Traditional socio-demographic variables did not capture all the motivations behind the Brexit vote, but psychological variables may offer additional insights beyond simple demographics.

These considerations inform this study's research questions: do psychological traits predict changes in voting behaviour? If so, which ones do? Can they improve socio-demographic models in how well they predict the recent shifts in voting behaviour?

As this article aims to understand shifts in the political landscape, it is important to focus on the changes in voting behavior that these shifts are attributable to. For this reason, we will focus on the voters who changed party between two general elections.

In particular this article will focus on switchers from the mainstream British parties (Labour, Conservative, Liberal Democrats) to UKIP between the general elections of 2010 and 2015. UKIP –the United Kingdom Independence Party- is a political party with a core purpose: to

take the UK out of the European Union. Switching to UKIP is therefore highly indicative of strong support for Brexit. Switchers to UKIP thus provide a strong proxy for examining whether demographics or psychographics predict the shifts to more nationalistic parties. The current volatility in party support in the UK clearly reflects a realignment of the electorate around the issue of Brexit. By looking back to the 2010-2015 elections, we can understand the different factors at play –socio-demographic or psychological- that were driving support for UKIP just before the 2016 referendum and that are important to understanding the results of the referendum and the political volatility that followed. In other words, switchers from the mainstream parties to UKIP were pre-runners of Brexit and the psychological factors that led them to switch hold a key to understanding the major shifts we are witnessing today. The 2010 and 2015 elections were relatively traditional, and comparable elections, called during the traditional electoral cycle. The reason for looking at UKIP switchers specifically is that they are one of the most visible expression of recent shifts to nationalistic parties worldwide. Trump's election and the electoral advances of the far-right Front National, Lega and AFD in the three largest European countries are other examples of these swings. The UK is a salient case study of such shifts as it was the first developed democracy to witness a major nationalistic swing of the electorate when the country voted to leave the European Union in 2016.

Focusing on switchers to UKIP from the three main parties also gives weight to our analysis as they form a large enough group of the population that they are well represented in open access databases. We will also look at all voters who switched their vote between the two elections. This will allow us to test whether the same psychological and socio-demographic factors that might be important in predicting specific switching directions, such as from mainstream parties to UKIP, will also predict overall levels of switching across all parties.

The data for this analysis come from the British Election Study (BES). The BES contains panel data on British voters, with a broad selection of socio-demographic, political and psychological variables. It provides a useful source of data to answer our research questions for several reasons. Firstly, it contains electoral, socio-demographic and psychological variables, which allows us to compare the effects of socio-demographic and psychological traits on voting in different elections. Secondly, BES surveys are conducted at different points in time, referred to as "waves". This study uses waves 6 and 7 which were conducted between 8 and 26 May 2015 and between 14 April and 4 May 2016, respectively. Wave 6 was used because it was conducted just after the 2015 general election, when voters would have been most likely to remember which party they had voted for. It contains data on voting choices at the 2010 and 2015 general elections, which allows us to operationalise switching between parties. Thirdly, the BES is an acceptably representative sample of the eligible voting population in the UK. Fourthly, the BES offered a large sample (N > 30,000) which afforded excellent statistical power.

This data will be used to address two primary questions:

Do psychological variables predict voter switching behaviour between 2010 and 2015 in the UK?

Are combined models with psychological and socio-demographic variables better predictors of switching behaviour than models with socio-demographic variables alone?

Methods

Sample

'Switching' is defined as the act of voting for different parties at the 2010 and 2015 general elections. This excluded voters who were too young to vote in 2010 but could vote in 2015. We looked at two types of switchers. The first type was voters who had switched from any party to any other party. The second type was voters who had switched from one of the mainstream British parties (Conservatives, Labour or Liberal Democrat) to UKIP. We used wave 6 of the BES for past vote as the data for this wave were collected between 8th and 26th May 2015, immediately after the 2015 general election. The proximity of the data collection to the last election attenuated the risk of incorrect vote recall by respondents. For panel respondents' 2010 vote, we relied on a vote recall question of the BES which read "Thinking back to the General Election in May 2010, do you remember which party you voted for then - or perhaps you didn't vote?". Relying on voters' recall of past vote entails the unavoidable risk of incorrect recall. Van Elsas et al. (2014, 2016) have shown that the probability of incorrect recall of past votes increases with time. However, the BES item we used asked respondents explicitly if they remembered which party they voted for and gives them the option to reply "Don't know". Focusing respondents' attention on whether they remember their past vote should mitigate the risk of incorrect recall.

The BES sample had the following demographic characteristics. It contained slightly more women than men, with approximately 54% women and 46% men. The mean age was 50.75 (SD = 16.6, range: 18 to 97), with approximately 28% of the sample aged from under 18 to 35, 29% aged 36 to 55 and 43% aged 56 to over 66. The ethnicity was as follows:

approximately 93% white, 0.8% black, 1.9% Asian, 1.3% mixed race and 3% 'other'. Figure 1 provides an overview of the parties 2010 voters voted for in 2015.

Wave 7 of the BES was used for variables that were not available in wave 6. This point requires an explanation. The BES does not ask the same questions in every wave, which means that some variables, such as age, were not available in wave 6. Wave 7 was used whenever a variable was not available in wave 6, as it was the closest in time to wave 6.

Measures

The following psychological and socio-demographic variables in the BES are used to predict voter switching between 2010 and 2015.

Authoritarianism measures how authoritarian each respondent's values are by asking respondents whether they agree or disagree with statements such as "Schools should teach children to obey authority" or "People who break the law should be given stiffer sentences". High authoritarianism scores indicate more authoritarian values. A score for each participant was constructed as the mean score across items. There are five items in the BES' authoritarianism scale.

Trust in MPs measures how much each respondent trusts MPs in general on a scale from 1 to 7. "1" indicates low trust while "7" indicates high trust.

The Big 5 personality traits are Openness to experiences, Conscientiousness, Extraversion, Agreebleness and Neuroticism. They were assessed using the Ten Item Personality Measure

(Gosling, Rentfrow, & Swann, 2003). Participants were asked: Here are a number of personality traits which may or may not apply to you. Please indicate the extent to which you agree or disagree with each trait. I see myself as...[adjective]. The adjectives were as follows: extroverted, quiet (measuring extraversion), dependable, disorganized (measuring conscientiousness) open to new experiences, uncreative (measuring openness to experiences), anxious, calm (measuring neuroticism) and critical, sympathetic (measuring agreeableness). Participants answered on a 5-point scale from 1 (Strongly disagree) to 5 (Strongly agree). A score for each participant for each of the Big Five traits was constructed as the sum score across the relevant two items.

Socio-demographic predictors typically used in the political science literature and by pollsters to predict voting outcomes included age, gender, geographic residence (geography), income, work type, work status and education level. Work status indicates whether the respondent is working full time, part time, is a student, a pensioner, unemployed or not working. Work type indicates respondents' professional rank and the type of activity they do. Its levels are: Professional or higher technical work; Manager or Senior Administrator / intermediate managerial / professional; Clerical/junior managerial/professional/administrator; Sales or Services; Foreman or Supervisor of Other Workers; Skilled Manual Work; Semi-Skilled or Unskilled Manual Work; Other; Has never worked.

Model design

All analyses were conducted using the statistical programming language R. The code used for all analysis steps can be found on the author's Github page which will be indicated after the peer review.

Four steps were taken to ensure that the model predicting switching probabilities was robust.

Firstly, the effect of each individual predictor on switching to UKIP and to another party was tested with a logistic regression for each predictor. Only the predictors with a statistically significant effect on switching were kept. We base this approach on Tukey's (1977) recommendation: "Where there are large numbers of possible predictors, it might seem natural to explore each variable independently prior to generating models to identify factors impacting strongly on the response. Doing so informally [...] is exactly what exploratory data analysis is about".

Secondly, a check was run to ensure there were no issues of collinearity between the variables under investigation. A recommended method to check for collinearity for categorical variables –as most of the variables in this study are categorical- is to check the generalised variance inflation factors of the predictors. Scores above 10 indicate a high level of collinearity between two variables so any variable with a score above 10 would be removed. The R function GVIF, which is specifically designed to test for this purpose, was used.

Thirdly, correlation plots were constructed with the remaining predictors to check whether there was a high level of correlation (above 0.5) between any pair of predictors. The correlation plot revealed that education level and work type were highly correlated. Work type was removed, as there was already a predictor relative to profession (work status) while there was only one on educational attainment.

The predictors that passed the four tests were included in a logistic regression to compare their effects on the likelihood of switching.

The fourth and final step consisted in obtaining probabilities of switching for different values of the psychological predictors. The predict() function in R was used to obtain probabilities by varying the value of each psychological predictor of interest while holding all other continuous predictors at their means. Categorical predictors were removed as they would have required us to calculate switching probabilities for each category. For example, for the "geographic residence" variable, 16 different probabilities would have had to be calculated for each of the UK's 16 regions.

Results

This results section first illustrates the direction of switching behaviour between different parties between 2010 and 2015 (figure 1), and then lists all of the psychological and socio-demographic predictors of switching and their significance levels (table 1). It then examines the performance of the psychological variables in predicting switching behaviour in the following order: switching from Labour, Liberal Democrat and Conservative to UKIP and overall switching. It examines in the same order the performance of the socio-demographic variables. Finally, it compares the performance of the different models by examining whether the combined models with both socio-demographic and psychological predictors reduce deviance significantly compared to the models with only socio-demographic predictors.

Figure 1 shows the parties 2010 voters voted for in 2015, illustrating the switching patterns that we analyse below. Each band has the color of the party voted for in 2015. It shows, for

example, that sizeable proportions of 2010 Labour, Conservative and Liberal Democrat voters switched to UKIP in 2015. The figure is based on the BES sample, not on the entire voting population.

Figure 1. Voting behaviour between the 2010 and 2015 general elections.

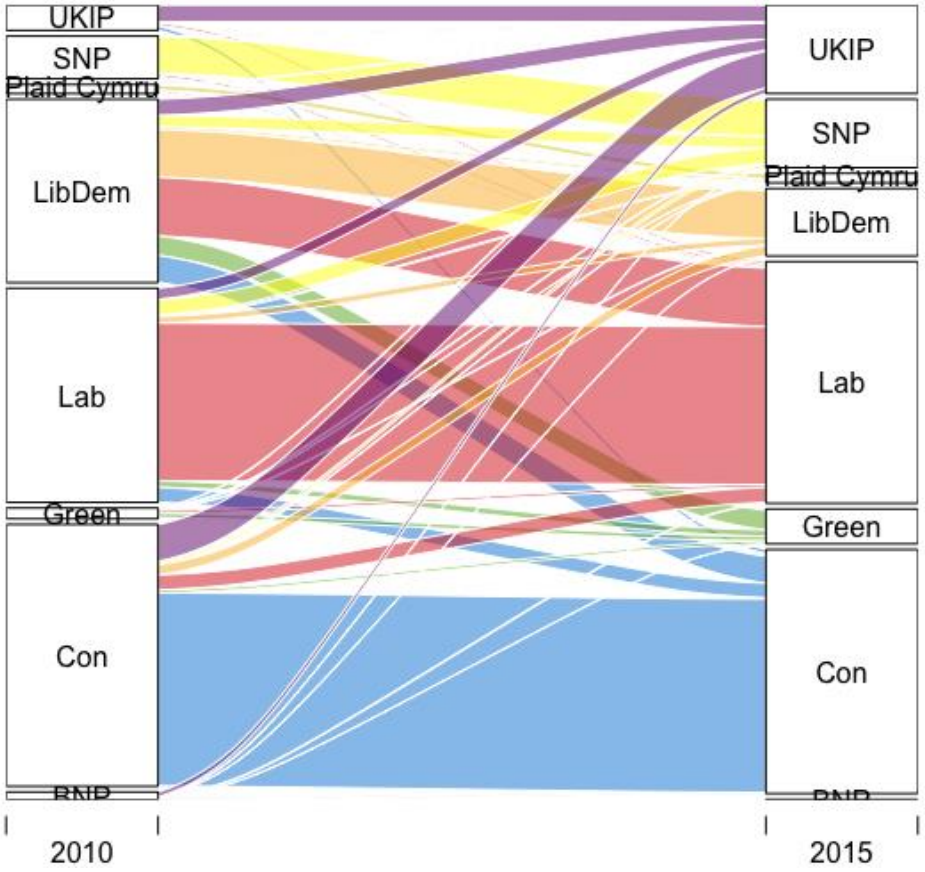


Figure 2 provides a more detailed description of switching behaviour between the 2010 and 2015 general elections, broken down by political party. Most voters voted for the same party in both elections. For example, figure 2 shows that among voters who had voted Labour in 2010, over 60% voted for Labour again in 2015 while less than 10% switched to UKIP and the Conservatives. Just over 30% of the people who voted Liberal Democrat in 2010 switched to Labour in 2015, which was slightly larger than those who voted Liberal Democrat again (~25%). The majority of voters who voted BNP in 2010 switched and voted UKIP in 2015. The proportions of voters from each party who switched to UKIP are as follows: Labour: 5.2% , Conservative: 14% , Liberal Democrat: 8.7% , SNP: 1.3% , BNP: 67.5%.

Figure 2: Which parties did 2010 voters vote for in 2015?

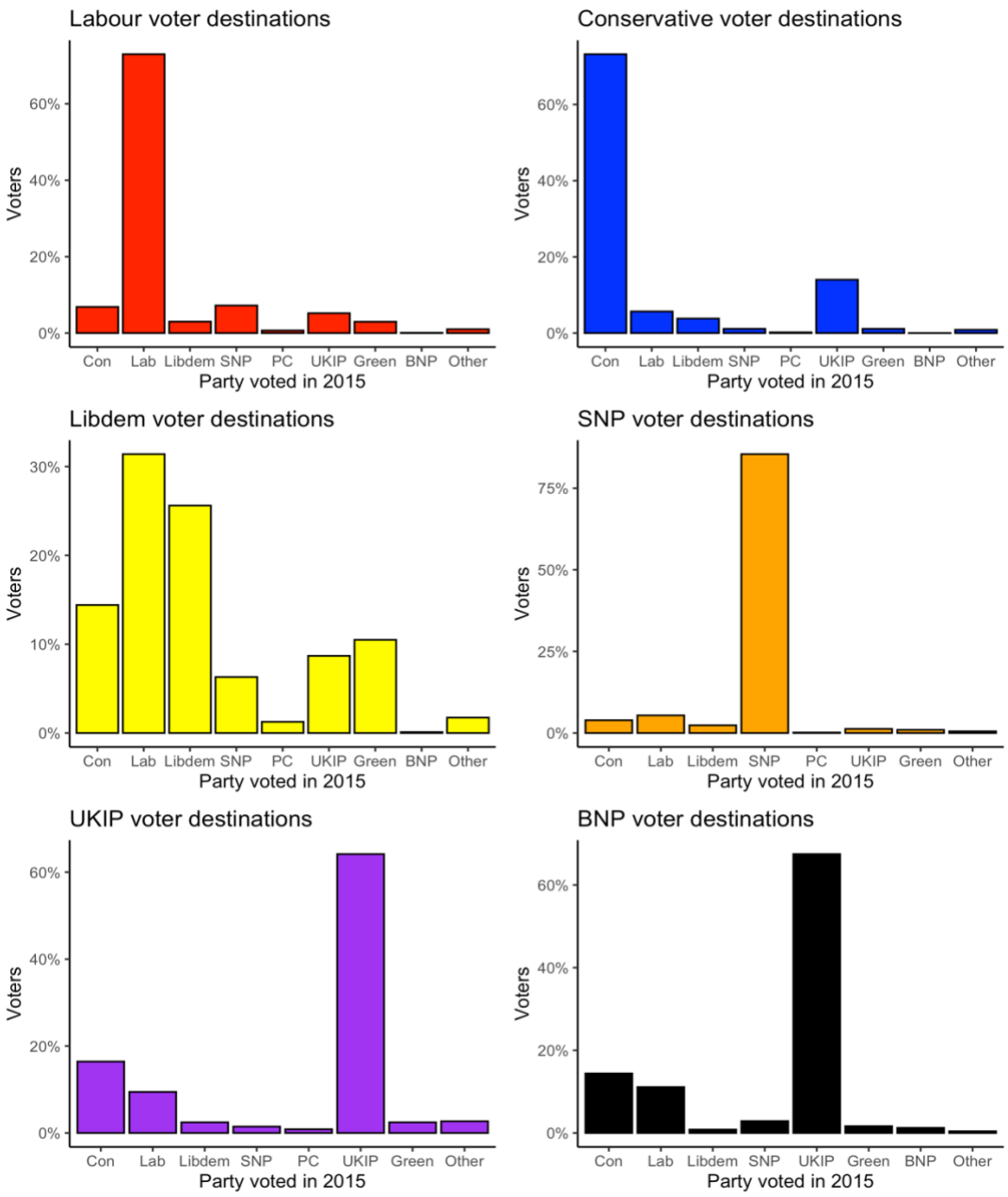


Table 1: effects of psychological and socio-demographic predictors on switching

	Labour to UKIP	Conservative to UKIP	Liberal Democrat to UKIP	All Voters
Authoritarianism	0.381 ***	0.164 ***	0.417 ***	
	(0.047)	(0.035)	(0.048)	
Trust in MPs	-0.217 ***	-0.762 ***	-0.368 ***	-0.287 ***
	(0.055)	(0.036)	(0.060)	(0.012)
Openness	-0.019		0.025	0.024 *
	(0.049)		(0.050)	(0.011)
Agreeableness		-0.031		
		(0.030)		
Neuroticism	-0.044		0.021	0.012
	(0.036)		(0.037)	(0.009)
Age				-0.014 ***
				(0.001)
Gender	-0.394 *	-0.306 **	-0.505 **	
	(0.166)	(0.114)	(0.182)	
Education Level	-0.058	-0.054	-0.336 ***	
	(0.061)	(0.039)	(0.071)	
Work Type				-0.022 **
				(0.008)
Work Status		0.067 *		
		(0.026)		
Income	-0.023	-0.058 **	0.013	-0.043 ***
	(0.035)	(0.020)	(0.032)	(0.007)
Ethnicity	-0.038			

	(0.047)			
Geography	-0.010	-0.029	-0.071 *	
	(0.024)	(0.019)	(0.031)	
N	2645	3438	997	13402
AIC	1196.667	2494.489	895.330	17185.528
BIC	1255.471	2549.773	939.473	17238.050

*** p < 0.001; ** p < 0.01; * p < 0.05.

Table 1 shows the log coefficient for each individual predictor on each type of switching, and whether each individual predictor had a statistically significant effect, at the 0.05 level at least, on the probability of switching to UKIP. Empty spaces indicate that the predictor didn't pass the robustness tests described in the Model Design section and wasn't included for that particular version of the model. Standards errors are in parentheses, the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC) are indicated at the bottom of the table for each model. Gender, ethnicity and geography were coded as factor (categorical) variables. Gender had two levels, with Male being the reference level. Ethnicity had 16 levels, with "White British" as the reference level as it contained the highest number of observations. Geography had 11 levels. Because there wasn't a specific region that we wanted to compare to the others, we kept "North East" as the reference level, as set in the defaults of the BES dataset.

Psychological predictors

The full regression results for each of these switching directions are provided in Table 1. Here we summarize the predictors that explain the most variance for each type of switcher.

Labour voters who switched to UKIP

Among the psychological factors investigated in our logistic model with psychological and socio-demographic predictors, authoritarianism ($p < 0.001$, $z = 8.19$) and trust in MPs ($p < 0.001$, $z = -3.97$) were significant predictors of Labour voters switching to vote for UKIP. In other words, Labour voters who scored more highly on authoritarian attitudes were more likely to cast a vote for UKIP in 2015 than less authoritarian Labour voters. Labour voters who were less trustful of MPs were more likely to switch to UKIP than Labour voters who were more trustful of MPs. We also modelled the probability of switching from Labour to UKIP by varying the value of authoritarianism while keeping all other variables constant. Labour voters with an authoritarianism score of 1 had a probability of switching to UKIP of 0.6%, whilst Labour voters with an authoritarianism score of 10 had a probability of switching to UKIP of 14.8%. In other words, a Labour voter with a very authoritarian personality was about 25 times more likely to switch to UKIP in 2015 than a Labour voter who did not have an authoritarian personality.

Conservative voters who switched to UKIP

Authoritarianism ($p < 0.001$, $z = 4.66$) and trust in MPs ($p < 0.001$, $z = -20.96$) were significant predictors of switching to UKIP for Conservative voters. As for Labour voters, the higher a 2010 Conservative voter was in authoritarianism, the greater was his or her likelihood of switching to UKIP. Conservative voters with an authoritarianism score of 1 had a probability of switching to UKIP of 2% while those with an authoritarianism score of 10 had a probability of switching to UKIP of 21.9%. Conservative voters who were less trustful

of MPs were more likely to switch to UKIP than Conservative voters who were more trustful of MPs.

Liberal Democrat voters who switched to UKIP

Authoritarianism ($p < 0.001$, $z = 8.610$), and trust in MPs ($p < 0.001$, $z = -6.09$) were significant predictors of switching behaviour to UKIP for Liberal Democrat voters. The higher a Liberal Democrat voter was in authoritarianism, the greater was his or her likelihood of switching to UKIP. Liberal Democrat voters with an authoritarianism score of 1 had a probability of switching to UKIP of 3.9% while those with a score of 10 had a probability of switching to UKIP of 58%. These scores should be interpreted with caution as the sample size of Liberal Democrat voters and switchers was much smaller than that of Labour or Conservative voters. This means that the number of observations for extreme authoritarianism scores was limited (for example, with 41 observations for an authoritarianism score of 1) which might explain the high probabilities obtained.

All voters

Looking at all the voters who voted for a different party in 2015 compared to the one they voted for in 2010 (so switching to any other party, not just to UKIP), authoritarianism was no longer a significant predictor of switching but trust in MPs was ($p < 0.001$, $z = -23.53$) as well as Big 5 openness ($p < 0.05$, $z = 2.26$). Voters with higher trust in MPs were less likely to switch to another party than voters with lower trust in MPs. Voters who scored higher on openness were more likely to switch to another party than voters who scored lower on openness.

Socio-demographic predictors

Labour voters who switched to UKIP

Among the socio-demographic variables, gender was the only significant predictor of switching from Labour to UKIP ($p < 0.05$, $z = -2.37$). Female voters were less likely to switch to UKIP than their male counterparts.

Conservative voters who switched to UKIP

Work status ($p < 0.05$, $z = 2.55$), gender ($p < 0.01$, $z = -2.7$) and income ($p < 0.01$, $z = -2.9$) were significant predictors of switching from the Conservatives to UKIP. Conservative voters who were not working were more likely to switch to UKIP than those working full time; female conservative voters were less likely to switch to UKIP than their male counterparts; individuals with higher levels of income were less likely to switch to UKIP.

Liberal Democrat voters who switched to UKIP

Education level ($p < 0.001$, $z = -4.7$), gender ($p < 0.01$, $z = -2.8$) and geographic residence ($p < 0.05$, $z = -2.3$) were significant predictors of switching from the Liberal Democrats to UKIP. Education level was a negative predictor of switching from Liberal Democrat to UKIP, with a lower education level indicating a higher probability of switching. As with Labour and Conservative voters, female voters were less likely to switch to UKIP than their male counterparts. Liberal Democrat voters in Scotland were less likely to switch to UKIP

than their counterparts in the North East, which was the reference category for our geographic residence variable.

All voters

Age ($p < 0.001$, $z = -10.36$), work type ($p < 0.01$, $z = -2.67$) and income ($p < 0.001$, $z = -6.44$) were significant predictors of switching from one party to another between 2010 and 2015. There was a negative correlation between age and switching, with younger voters more likely to switch than older ones. For example, voters who were 22 years old in 2010 had a 49.5% probability of switching parties while this probability fell to 28.8% for 88-year olds.

Predictive power of the overall models

Our analysis so far has answered our first question: certain psychological variables –namely authoritarianism, trust in MPs and Big 5 Openness- significantly predicted voter switching behaviour. Our second research question asks whether combined models with psychological and socio-demographic variables were better predictors of switching behaviour than models with socio-demographic variables alone.

In order to answer the second question, we computed likelihood ratio tests to compare the combined models with both psychological and socio-demographic variables and the models with only socio-demographic variables. This allowed us to see if they significantly reduced deviance, which is the equivalent for logistic models of how much variance is explained. The p-value of the chi-square statistic obtained from each likelihood ratio test indicates whether

the model with the added parameters –the psychological variables in addition to the socio-demographic variables- is worth the added complexity.

In all the model comparisons, the chi-square statistic of the likelihood ratio test comparing the combined model to the model with only socio-demographic predictors was significant ($p < 0.001$).

Table 2: Analyses of Deviance

Model name	χ^2	**df**	**p-value**
Labour voters – Combined model	-18.32	-4	0.001
Conservative voters – Combined model	-144.3	-3	< 0.001
Liberal Democratic voters – Combined model	-29.91	-4	< 0.001
All voters – Combined model	-122.82	-3	< 0.001

Table 2 indicates the results of the likelihood ratio tests comparing the combined models to the models with only socio-demographic variables. For example, the analysis of deviance table for Labour voters shows that the combined model reduces deviance by 18.32 compared to the model with only socio-demographic variables –this number is also known as the chi statistic- and that this effect is highly significant.

Discussion

The current study examined the psychological and socio-demographic characteristics of voters who switched parties between the 2010 and 2015 UK general elections. The answer to our first question is that certain psychological variables predicted switching behaviour. The most striking result of this analysis is that authoritarianism and trust in MPs predicted

switching from the mainstream parties to UKIP. Higher authoritarianism and lower trust in MPs predicted switching from Labour, the Conservatives and the Liberal Democrats to UKIP. When looking at all voters who switched, trust in MPs and Big 5 Openness predicted switching to other parties (not specifically UKIP). Voters with higher trust in MPs and higher openness scores were more likely to switch parties.

Among socio-demographic predictors, gender was a significant predictor of switching, with male voters more likely to switch from the mainstream parties to UKIP than female voters. This effect was not present when looking at all voters, which suggests that although women were less likely than men to switch to UKIP, they were as likely to switch to other parties. Age was also a significant predictor of switching when looking at all voters, with younger voters more likely to switch to other parties (not specifically UKIP) than older voters.

Interestingly, trust in MPs predicted switching not only to UKIP but to any party. Our expectation would have been to see low trust in MPs predict switching to UKIP specifically, similarly to authoritarianism, and to see this effect disappear when looking at all voters and all switching directions. The reason to expect this is that distrust towards MPs is often associated with anti-establishment political behaviours, such as support for UKIP. It could be that voters dissatisfied with the party they voted for decided to switch at the following election. This would explain why we see switching in all directions. However, this interpretation remains speculative and requires testing which is beyond the scope of this article.

The finding that authoritarianism predicted voters switching to UKIP in this analysis is consistent with previous work from Zmigrod, Rentfrow and Robbins (2018) who found that

higher authoritarianism was predictive of support for Brexit. De Wit and Lewis (2019) also find that subgroups of the UK population with more individuals who wanted to leave the EU scored higher on the same measures of authoritarianism used in the present study. The current findings extend these results by showing that not only does authoritarianism explain support for extreme political behaviours, it also sheds light as to why previously moderate voters come to adopt those behaviours. Our findings highlight the major role of authoritarianism and trust in MPs in shaping political allegiances prior to the 2016 referendum.

The present article's results, like those of Ekstrom and Federico (2019), identify an effect of personality traits (openness in our case) on changes in political attitudes. Although we do not find that openness predicts switching to specific parties, we do find that it predicts overall switching. In fact, when looking at all switchers, authoritarianism was not a significant predictor of switching but openness was. In other words, voters with more open personalities were more likely to switch parties. The process through which this happens seems intuitive: more open-minded individuals are more likely to change their minds as to which party they will vote for. However, it is important to note that openness only improves the model's predictive power marginally.

Our second question asked if the combined predictive models with psychological and socio-demographic variables were better predictors of switching behaviour than socio-demographic variables alone. The results of the likelihood ratio tests indicated that the combined models performed better in predicting switching behaviour. This is an important finding as many political science studies and polling methods still rely overwhelmingly on socio-demographic variables to forecast or explain voting behaviour. Traditional demographic variables such as age and gender are still important factors behind voting behaviour. For example, our finding

that younger voters were more likely to switch to another party (not specifically UKIP) than older ones is consistent with previous literature such as Alwin (1994) and Sears (1983) who find that younger cohorts of participants tend to have less stable party identification than older ones.

A number of limitations require mentioning. First, the goal of this study was to compare psychological and socio-demographic variables to see which performed best in predicting switching behaviour. Our focus was on psychological variables such as authoritarianism, trust in MPs and personality traits. However, there are other psychological variables in the BES that could have been included, for example empathy and the subjective sense of control over one's life. The question then becomes how much added insight would we obtain from other psychological variables in the BES and in other datasets, which could be the object of further research. Second, the personality measures employed in the analysis were based on a shortened form of the Big 5 Personality traits (Gosling et al, 2003), with each personality trait measured with two items per domain instrument. Measuring personality traits with a more extensive questionnaire would have allowed a more granular analysis of personality differences than what was possible with the BES. Third, we must caveat the causal claim we made, that the relationships we found between certain psychological variables and switching can be extended to the general voting population. Our findings rely on a sample which, although it had a large N size, is never perfectly representative of the entire population.

In summary, our findings highlight that psychological measures can add to our understanding of shifts in political behaviour, but that socio-demographic variables still play a leading role.

***

We have shown that personality and psychological variables have effects of varying importance in shaping switching behaviour, providing support to the theory that there are psychological characteristics specific to swing voters. We found that Openness to new experience is such a characteristic, even if not among specific subgroups of swing voters like those who switched to UKIP. However, the Big 5 personality traits constitute very broad constructs at the highest level of abstraction, subsuming myriads of more specific personality types (John and Srivastava, 1999). The Big 5 personality traits are often thought of as a helpful description that captures a considerable amount of what varies across individuals. Their main utility is their heuristic value (John and Srivastava, 1999). However, underpinning each dimension of personality is a complex host of other cognitive and emotional mechanisms and this complexity and granularity are lost by the level of abstraction of the Big 5. This prevents us from identifying which of these specific mechanisms leads some individuals to be swing voters, making it interesting to measure specific cognitive mechanisms in detail. Indeed, swing voters may differ on some cognitive mechanisms compared to other voters. Differences in how people think, in how they process information may shed light on what sets swing voters apart from other voters.

To go further in exploring differences between swing voters and other voters, the next step was to explore whether the former also think differently from the latter. The challenge this represents is double because it requires identifying candidate cognitive processes on which swing voters differ from other voters and finding ways to measure these differences. We seek to identify differences in cognitive processes but there are multiple cognitive processes at work in complex activities such as political cognition and decision-making. We needed to

narrow down the candidate cognitive processes that we may observe differences on between swing voters and other voters.

The evidence uncovered in our first chapter constituted a starting point. Our first study found that swing voters had higher openness to experience compared to other voters and that those who switched from mainstream parties to far-right parties scored higher on authoritarianism. Higher openness to new experience could represent distinct ways of processing new information, warranting further exploration. We also examined whether differences in authoritarianism also accounted for differences between swing voters and others. Authoritarian personalities have specific cognitive correlates which affect cognitive processes and could explain why some voters swing to far-right parties while others don't. For example, heightened authoritarianism was associated with subjective and objective cognitive inflexibility (Zmigrod et al., 2018). Citing Rokeach's work (1960), Karen Stenner argued that "authoritarians are truly the most changeable, the most readily malleable […]. They are […] avoiders of complexity far more than closed-minded avoiders of change" (Stenner, 2009).

It is important to note that we hypothesise differences in *how* swing voters and other voters think rather than in *what* they think. As discussed in the Introduction, although swing voters may care more about economic issues than other voters, this is not a consistent or robust finding. There is no strong evidence that swing voters differ from others in terms of the content of political cognition. For this reason, we focused on the cognitive processes potentially common to all swing voters beyond the sole political domain.

Author contribution statement

Emmanuel Mahieux designed research, carried out data collection, data processing, statistical analyses, generated figures and wrote different versions of the manuscript. Lee De Wit

designed research, provided feedback and edited successive versions of the manuscript. Joe Devlin designed research and edited the manuscript. Liza Karmannaya and James Ackland reviewed the R code.

Chapter 2 - Cognitive correlates of swing voting: do swing voters process information differently from other voters?

Introduction

A key criticism in the political psychology literature is that measures of psychological attitudes sometimes include content that is overtly political in nature (Taber and Lodge, 2013). This can result in tautological findings where the predictor variable is so conceptually similar to the phenomenon of interest that the relationship between them does not offer any novel insight into the psychological processes that might underpin that relationship. This criticism has frequently been made with regards to the right-wing authoritarianism (RWA) scale, as many versions of that scale include items that are overtly political in nature.

One response to this criticism is to study cognitive processes objectively, rather than measuring attitudes that are already political in nature. Rollwage et al. (2019) stressed the utility of this approach, arguing for the study of "cognitive styles" that are free of any particular content. Taber and Lodge made a similar appeal to researchers of political cognition, calling for new independent variables "scrubbed of political content" in order to explain political attitudes with cognitive process rather than political content, prioritizing "more reaction-time measures, measures of performance on tasks unrelated to politics or culture, and other culture-irrelevant measures" (p. 531).

To establish whether there are different cognitive styles between individuals holding different political attitudes, we must look at differences in cognition outside the political domain. If

individuals have different cognitive styles, they should present different ways of thinking in all domains of cognition, not only in the political domain. This requires us to assess cognitive style in a domain-neutral way to make sure that we capture differences that apply to all domains of cognition.

A key cognitive process in political decision-making is the ability to update beliefs in light of new information, especially when that information runs counter to prior beliefs. This is particularly important with political beliefs as voters should be able to update their political beliefs in light of new information, such as a politician's record while holding public office, and determine their voting behaviour accordingly. A large body of research in political psychology has looked at the underlying processes that hinder or facilitate belief updating in voters.

Research by Rollwage and Fleming (2018) showed that individuals holding radical political beliefs presented lower metacognitive sensitivity and higher confirmation bias compared to individuals with moderate beliefs. Metacognitive sensitivity is the insight into the correctness of one's beliefs. Participants holding radical beliefs had a reduced ability to correctly assess their objective performance on a perceptual task, mainly because of unreasonably high confidence in their performance. The findings showed that participants with more radical or dogmatic beliefs integrated new, disconfirmatory evidence less and updated their beliefs to a minor degree than moderate participants, although the study identified only a small link, with metacognitive sensitivity explaining only approximately 2% of dogmatic and radical beliefs. De Beukelaer et al. (2023) confirmed this pattern on the specific issue of climate change: individuals with greater metacognitive sensitivity were more likely to update their beliefs on the issue of climate change, while overconfident individuals were less likely to do so. This

research established a link between higher metacognitive sensitivity and enhanced belief updating.

Studies on polarisation showed how confirmation bias can lead partisans and non-partisans to update their beliefs differently in light of the same information, underscoring asymmetries in the way they update their beliefs. Participants who strongly believed in anthropogenic climate change updated their beliefs more when receiving undesirable information (e.g. temperatures rising more than expected) as such information validated their prior beliefs (Sunstein et al., 2016). Inversely, people who weakly believed in climate change updated their beliefs more when receiving desirable information (e.g. temperatures rising less than expected). Goldberg et al. (2022) found that messaging on the scientific consensus regarding climate change led even people with extreme beliefs to update their beliefs. Their messaging had the most durable effect among participants who were doubtful or dismissive of climate change. Critically, certainty in one's beliefs moderated this effect, as the messaging led to greater belief updating among individuals with lower certainty on the issue compared to those with high certainty, although all participants updated their initial beliefs. This confirmed the asymmetrical effect that the same information can have on belief updating among individuals with respectively low and high confidence in their beliefs.

Another reason that some researchers have put forward to explain differences in belief updating is the cognitive correlates of different political behaviours and ideologies hypothesised to hinder or facilitate belief updating. The emphasis has been on the correlates of right-wing or conservative ideology. Many researchers have claimed that conservative ideology or alignment with right-wing parties is associated with an ample range of cognitive biases that impede belief updating: dogmatism, avoidance of ambiguity and complexity,

craving for certainty or "closure" in argumentation (Jost et al., 2003; Jost et al., 2008; Feygina et al., 2010), general unwillingness to revise beliefs, and heuristic-driven information processing rather than reflexive, System 2-type thinking when appraising policy issues (Iyer et al., 2012; Pennycook et al., 2012). Some have argued that US conservatives presented greater resistance to engaging with different political viewpoints than liberals did (Nam et al., 2013) and that ideologically motivated cognition is particularly prominent among conservatives because of the negative correlation they found between conservatism and open-minded thinking (Jost et al., 2012; Nam et al., 2013). The attribution of these cognitive biases to conservative ideology and alignment with right-wing parties has often been referred to as the "rigidity of the right" hypothesis (Taber and Lodge, 2013), and generally posits that political conservatives are less flexible and open-minded in their thinking than others, a theory that originated with Adorno, Frenkel-Brunswik and Rokeach's work on authoritarianism (Jost et al., 2003).

However, not all research corroborates the rigidity of the right hypothesis, with some researchers finding that individuals from all political sides present these cognitive biases and the relative difficulties to update beliefs. Kahan et al. (2012) found that motivated reasoning can skew perceptions symmetrically across different political groups, without one being more or less affected than the other. Zmigrod et al. (2019) showed that partisans holding extreme political views presented lower cognitive flexibility on non-political tasks compared to moderates and that this difference applied regardless of political orientation. Crawford (2012) reported that ideological attitudes bias political judgement and decision-making regardless of left or right-wing positioning. In a meta-analysis of 51 experimental studies, Ditto et al. (2017) showed that there was no significant difference in mean partisan bias between conservatives and liberals. Another meta-analysis by Costello et al. (2023) found that the

association between conservatism and cognitive rigidity was heterogeneous, noting that although social conservatism was significantly associated with rigidity, economic conservatism was not, particularly outside of the United States.

Thus, the field has looked for the processes underlying belief updating or the failure to update beliefs in different processes: motivated cognition, confirmation bias and polarised thinking and the cognitive correlates of political ideology and behaviour. These approaches have tested for differences between different groups of partisans or between partisans and non-partisans.

It is striking that few studies on political belief updating have looked at the group of people who are known to update their beliefs -and behaviour: swing voters. Swing voters represent a real-life case of belief updating as they change their beliefs to the point that they change their behaviour as well: the way they vote. To our knowledge no research has explicitly tested whether swing voters differ in measures of objective cognitive decision making and belief updating tasks. The dominant focus on belief updating in partisans has left a gap in the literature on belief updating in swing voters which the present work seeks to address.

The aforementioned evidence suggests that partisan voters and individuals who are politically more extreme tend to have an impaired ability to update their beliefs and integrate disconfirmatory information. The presence of these biases in partisans is associated with their difficulty to change their minds and with the persistence in the way they vote. If biased information processing is what prevents partisans from updating their beliefs and changing their voting behaviour, it poses the question of whether unbiased information processing is what allows swing voters to update their beliefs. We seek to establish whether swing voters

present less bias than other voters in their information processing and belief updating processes.

There are multiple cognitive processes that affect information processing and belief updating. Two that have been highlighted in previous work are highly pertinent to swing voting: confirmation bias (Wason, 1960) and metacognitive sensitivity (Rollwage and Fleming, 2018; Beukelaer et al., 2023). Confirmation bias is the tendency to accept unquestioningly information that confirms our beliefs. Its corollary is disconfirmation bias, the tendency to reject information that disconfirms our beliefs.

Metacognitive sensitivity is the ability to correctly assess our own beliefs and decisions and is critical to belief updating. As mentioned previously (De Beukelaer et al., 2023), individuals with greater metacognitive sensitivity were more likely to update their beliefs on the issue of climate change. We also know that individuals holding dogmatic or radical views have lower metacognitive sensitivity compared to moderates (Rollwage and Fleming, 2018). Given this evidence, it is possible although not necessary that individuals who update their beliefs have higher metacognitive sensitivity than those who don't. Thus, it is possible that swing voters, who update their beliefs, have higher metacognitive sensitivity than partisans, who do not update them.

Rollwage and Fleming (2018) proposed an experimental task that estimates both confirmation bias and metacognitive sensitivity at the individual and group level. We employ this task to test whether swing voters display greater metacognitive sensitivity and lower confirmation bias in their processing of information compared to other voters. In the task, participants are asked to discriminate between visual stimuli and then to assess how confident

they are in the correctness of their choice. On certain trials, they are given no additional information on the correctness of their choice while on other trials they are given additional "clues", that provide an opportunity for participants to update their decisions. We use this task to assess metacognition and confirmation bias in the context of the US 2020 election, recruiting an online sample of participants who voted for the same candidate in 2016 and 2020, and participants who switched their vote between 2016 and 2020.

The task presents the advantage of measuring both metacognitive sensitivity and confirmation bias without making use of political content. Several tasks (Lord et al. 1979, Vallone et al. 1985, Taber and Lodge, 2006) measured shifts in polarisation and directions in which beliefs were updated by giving participants information on salient political issues and recording policy preferences before and after the task. The issue with such an approach is that it measures changes in attitude on a specific political issue without assessing the underlying cognitive processes at work. We would like to understand if there is a fundamental cognitive difference in how swing voters process information compared to other voters rather than attitude shifts on one specific issue.

Moreover, the task offers an objective measure of belief updating determined by participants' responses to neutral perceptual stimuli rather than by their subjective self-reports. This way, it provides a quantitative measure of metacognitive sensitivity and confirmation bias which is often not the case with measures of political cognition and belief change.

Furthermore, as D. Chong (2013) noted, one of the major objections made to the validity of survey and experimental demonstrations of biased political information processing is that participants aren't given the opportunity to learn from their errors of reasoning. The task we

used addresses this concern as it gave participants the opportunity to learn from their errors by giving them additional information on the correctness of their decision.

Methods

Participants

We tested our hypothesis with voters who voted in the 2016 and 2020 US presidential elections. Participants were recruited through the web platform Prolific. Using Prolific's custom filters, swing voters were recruited by identifying participants who voted for Trump in 2016 and switched to Biden in 2020. They are referred to as "swing voters" or "switchers" in the present article as they "switched" from one candidate to another between elections. Those who voted for Trump in 2016 and 2020 are referred to as "other voters" or "stickers" as they "stick" with the same candidate. When participants clicked to take the study, they were asked before beginning who they voted for in 2016 and 2020 to ensure that they met the study inclusion criteria. Lack of alignment between the vote recall before taking the study and the voting history given to Prolific led to participant exclusion. This step reduced the potential for incorrect vote recall by participants.

We confined our sample to participants who voted for Trump in 2016 for three reasons. The main direction of switching in the 2020 presidential election was from Trump to Biden and there were not enough switchers from Clinton in 2016 to Trump in 2020 to attain the desired level of statistical power. Testing our hypotheses on swing voters who switched from Trump to Biden allows us to shed light on the voters whose change of mind decided the outcome of the election. Finally, the Democratic candidate was different in 2016 and 2020 which would

have made switching from the Democratic to the Republican candidate more difficult to compare.

After being invited to complete the experiment, participants were asked the following questions:

“Who did you vote for president in 2016?”

“Who did you vote for president in 2020?”

Those who answered “Trump – Biden” and “Trump – Trump” were directed to the experiment. Participants who answered differently were not invited to continue. The purpose of these questions was to ensure that participants were either Trump to Biden switchers either Trump stickers and that no abstainers, third party voters or Clinton to Trump switchers were included.

We conducted a power analysis prior to data collection to determine the sample size required for power at 0.8. We used the R package pwr, setting the following inputs: two groups, power at 0.8 and an expected effect size of 0.15. The power analysis indicated that 175 participants per group were needed.

We recruited 340 participants on Prolific who voted at the 2016 and 2020 US presidential elections (Female = 183, Male = 157). In terms of ethnicity, 293 participants were white, 7 African-American, 13 Asian, 12 mixed race, 3 Native American, 11 Latino, 1 Middle-Eastern. The mean age was 37.9 years (SD = 11). In terms of their vote, 168 participants

voted for Trump in 2016 and switched to Biden in 2020 while 172 voted Trump in both elections.

We achieved similar sample sizes of switchers and stickers by capping the number of places in our online task at 175 for each group. The places for stickers were rapidly filled as there were more stickers than switchers at the 2020 presidential election, and hence more eligible participants. To reach a similar number of switchers, we sent notifications of the task to eligible particpants multiple times until a similar number of switchers signed up.

Participants were paid £7.5 per hour for their time, in line with UCL policy. This experiment was conducted under UCL ethics form EP/2019/003.

Procedure

The experiment was conducted online using the web platform Gorilla and participants were required to use full-screen mode to complete it on a computer. The entire experiment took between 60 and 70 minutes to complete.

In the Rollwage and Fleming (2018) task that we used, participants were shown two black screens side-by-side for 750 ms. Flickering white dots appeared on each screen. One of the two screens had more flickering dots than the other. The difference in dot number between the two squares determined the level of evidence given to participants. In some trials, this difference was clear: one screen clearly had more flickering dots than the other. These were high-evidence trials. In other trials, the difference was unclear: the two screens seemed to have the same number of flickering dots, although one had slightly more dots than the other.

These were low-evidence trials. In each trial, the participant had to indicate which of the two screens contained more flickering dots. The experiment comprised three phases: calibration, confidence, and post-decision evidence integration.

The first phase was a 2-down-1-up staircase procedure, with two consecutive correct answers leading to a decrease in the evidence level and one incorrect answer leading to an increase in the evidence level. The aim of this staircase procedure was to produce a 71% accuracy rate on low-evidence trials. If the participant chooses correctly (i.e. chooses the screen with the highest number of flickering dots), then the selected screen will have a green contour. For incorrect choices the selected screen will have a red contour. This calibration phase consisted in 120 trials. Participants completed 70 trials of the staircase and the average of the last 25 trials was stored and used as the individual stimulus strength throughout the rest of the experiment.

After calibration, the second phase was a "confidence task" consisting of 60 trials. On each trial, participants first chose the screen they perceived to have the highest number of flickering dots and did not receive feedback on whether their choice was correct or not. Participants then rated their confidence in their choice on a scale of 1 to 9, with 1 being not confident and 9 being very confident. This phase measured participants' baseline confidence in their perceptual decisions.

The third phase was called the "post-decision evidence integration task" and consisted of 120 trials. After deciding which screen had more dots, participants were shown an additional screen which either provided additional evidence as to which screen had more flickering dots (i.e. high post-decision evidence, 60 trials) or remained unclear as to which screen had more

flickering dots (i.e. low post-decision evidence, 60 trials). The post-decision evidence was always correct, that is, no misleading evidence was provided. After viewing the post-decision evidence, participants were asked to rate their confidence in their original choice. As in the previous phase, no feedback was provided.

This phase measured participants' ability to integrate new information after making their initial decision and was the key test of confirmation bias. If participants' decisions were incorrect, this should have led them to update their beliefs, that is, to change their mind on which screen had more dots. When rating their confidence on an incorrect trial, participants should have had low confidence in their decision, as they should have integrated post-decision evidence suggesting that it was incorrect.

However, this required participants to integrate post-decision evidence which disconfirmed their belief. As Rollwage and Fleming (2018) show, not all participants conform to this expectation. Many participants discard the disconfirmatory evidence and hold on to their beliefs, even after receiving evidence that those beliefs are incorrect, giving high confidence ratings of their incorrect decision. This is an instance of confirmation bias.

Confirmation bias takes two forms: ignoring disconfirmatory evidence and embracing confirmatory evidence. Therefore, we had two variables for confirmation bias: disconfirmatory evidence integration and confirmatory evidence integration.

We tested whether swing voters had lower confirmation bias and higher metacognitive sensitivity than other voters with four different methods: a t-test of the degree of updating between the groups (swing vs non swing voters), a set of ANOVAs testing the same

difference but controlling for additional variables, a set of logistic regressions using measures of updating (and control variables) to predict swing voting and likelihood ratio tests to test whether our measures of updating improved different models' explanatory power.

1) Linear models

The first measure of confirmation bias we used followed Rollwage and Fleming's (2018) operationalization by building linear models where the dependent variable was each participant's confidence ratings and the predictor was post-decision evidence strength. The post decision evidence had three levels: 0 for the confidence task trials, 1 on trials with low post-decision evidence strength and 2 on trials with high post-decision evidence strength. The rationale behind this coding was that if the participants integrated new evidence, then their confidence should increase progressively depending on the trials. In confidence task trials, they were given no new evidence after making their decision so their confidence shouldn't have changed. In trials with low post-decision evidence strength, they were given new post-decision evidence although it was unclear (as it was the same evidence strength as in the pre-decision screens). Confidence in the correctness of their decision should have increased more than when they received no new evidence. In the trials with high post-decision evidence strength, they were given new evidence which was clearer so confidence in their decision should have increased more than when the new evidence was unclear.

The linear models were run separately for correct trials and for incorrect trials. The beta of each model indicated if participants updated their belief (on which of the two screens had more dots) or not. For correct trials, a positive beta indicated that the post-decision evidence increased the participant's confidence, while a negative beta indicates that it lowered the

participant's confidence. In other words, the beta indicated the extent to which the participant integrated evidence. For incorrect trials, the sign of the beta was reversed so that higher values indicated greater integration of disconfirmatory evidence.

We sought to test if swing voters had lower confirmation bias than other voters. If this were the case, we should have seen greater integration of disconfirmatory evidence on incorrect trials among swing voters than among other voters. We should also have seen lower integration of confirmatory evidence on correct trials among swing voters than among other voters. These considerations informed our first and second hypotheses:

H1: Swing voters integrate disconfirmatory evidence *more* than other voters.

H2: Swing voters integrate confirmatory evidence *less* than other voters.

We tested H1 by comparing the beta coefficients of swing voters on incorrect trials to the beta coefficients of other voters on incorrect trials. The beta on incorrect trials should have been higher for swing voters than for other voters, indicating that they integrated disconfirmatory evidence more than other voters. We followed the same procedure for H2, by comparing the beta coefficients of swing voters and other voters on correct trials. The beta on correct trials should have been lower for swing voters than for other voters, indicating that confirmatory evidence increases swing voters' confidence in their beliefs less than it did for other voters. This comparison approach allows us to see if the two groups differed in how they integrated evidence.

The comparisons of the beta coefficients were tested using between-subjects t-tests.

In order to assess the potential role of other variables that might co-vary across participants, we also conducted ANOVAs with several co-variates.

2) ANOVAs

We ran two separate ANOVAs examining whether swing voters and other voters differed on disconfirmatory and confirmatory evidence integration. The covariates we controlled for included sex, ethnicity, income level, employment status, professional category, education and right-wing authoritarianism.

3) Logistic regression

The linear models and ANOVAs described above tested whether swing voters had lower levels of confirmation bias than other voters. We were also interested in a related although distinct question, which is whether confirmation bias predicts swing voting. In order to answer this question, we ran logistic regressions to test if disconfirmatory evidence integration and confirmatory evidence integration significantly predicted switching from Trump to Biden. This goal informed our third and fourth hypotheses:

H3: Disconfirmatory evidence integration predicts switching from Trump to Biden.

H4: Confirmatory evidence integration predicts swing voting from Trump to Biden.

As before, we included age, sex, ethnicity, education and authoritarianism as control variables.

We computed likelihood ratio tests to compare the models with our variables of interest and the control variables to models with only the control variables. This allowed us to see if our variables of interest significantly reduced deviance, which is the equivalent for logistic models of how much variance is accounted for. The p-value of the chi-square statistic obtained from each likelihood ratio test indicates whether the model with the added parameters –disconfirmatory and confirmatory evidence integration in addition to the control variables- is worth the added complexity. We ran two separate likelihood ratio tests: one with disconfirmatory evidence integration and the control variables and one with confirmatory evidence integration and the control variables.

If H3 and H4 were correct, then the chi-square statistic of each likelihood ratio test should have been significant. This would mean that disconfirmatory and confirmatory evidence integration significantly predicted whether someone switched from Trump to Biden or not.

Metacognitive sensitivity

We would also like to know whether swing voters had higher metacognitive sensitivity compared to other voters. If so, it would indicate that swing voters had a better capacity to estimate their confidence on correct vs incorrect trials on a perceptual task.

In signal detection theory, d' refers to the ability to discriminate between states of the world, in our case the ability to discern which of the two screens contains more flickering dots. d' is

participants' observed performance on the perceptual task, which is the proportion of trials for which participants made the correct choice. The perceptual task is also known as the "type 1 task". Meta-d' refers to metacognitive sensitivity.

Metacognitive sensitivity can also be calculated as a ratio: meta-d'/d' also referred to as Mratio. Meta-d'/d' is a measure of metacognitive efficiency, that is, "given a particular level of task performance, how efficient is the individual's metacognition"? If meta-d' is equal to d', then the observer is metacognitively 'ideal', using all the information available for the task when reporting confidence.

To summarise, meta-d'/d' measures metacognitive efficiency adjusted for performance on the task and is not affected by the tendency to report high or low confidence (overconfidence bias). To estimate meta-d'/d', we followed the steps indicated by Stephen Fleming (HMeta-d; https://github.com/metacoglab/HMeta-d).

The hypothesis that we tested with meta-d'/d' was therefore:

H5: Swing voters have higher metacognitive sensitivity than other voters.

We explain the different steps to calculate meta-d'/d'. Meta-d' is defined as "the value of type 1 performance (d') that would have been predicted to give rise to the observed confidence rating data assuming a metacognitively ideal observer with type 1 d' = meta-d'" (Fleming, 2017, p. 2, §3). In other words, in meta-d', the observed confidence ratings are used to predict what the perceptual task score should have been assuming the participant had perfect accuracy, i.e. a performance-confidence correlation of 1:

$$\text{meta} - \text{d}'/\text{d}' = \frac{\text{d}' \text{predicted from participant's observed confidence ratings, assuming perfect accuracy}}{\text{participant's observed d}'}$$

For example, we could imagine a scenario in which participants' confidence ratings, assuming perfect accuracy, would indicate that their d' should be 0.80. However, their actual d' is 0.60. The resulting meta-d'/d' of 0.80/0/60 = 1.33 indicates that on average participants exhibited imperfect metacognitive efficiency as the ratio was approximately 33% above what would have been predicted from their perceptual task performance. Values of meta-d'/d' greater than 1 indicate overconfidence while values of meta-d'/d' smaller than 1 indicate underconfidence.

The simplest way to calculate meta-d' is by calculating the distance between the type 1 distributions for S1 and S2 in standard deviation units. To explain, our data were structured as counts. When the screen with the highest number of flickering dots was the screen on the left, the stimulus was S1. When it was the screen on the right, the stimulus was S2. Each participant had to choose S1 or S2 at each trial. Stimuli IDs and participant responses were stored as counts in vectors S1 and S2. Participants' correct and incorrect responses can be plotted as two separate distributions onto an x axis measuring confidence. The distance between these distributions can be measured in standard deviation units and corresponds to meta-d' (Maniscalco and Lau, 2012, Supplementary Materials, p. 2).

Other measures

Authoritarianism. We collected data on authoritarianism as previous studies found associations between authoritarian personalities and metacognitive sensitivity (Rollwage et

al, 2018) and between authoritarianism and belief updating (Sinclair et al, 2020). The measure of authoritarianism that we used is Engelhardt et al's (2021) 8-item scale of child-rearing values. This scale was chosen over other frequently used scales (such as Altemayer, 1981) because it attempts to assess authoritarianism in terms that are not explicitly political. Moreover, it is helpful to test whether swing voting is related to confirmation bias in a way that is separate from individual differences in authoritarianism. The child-rearing scale asks participants to choose which of two desirable qualities a child should have. The scale's items are:

Would you say that it is more important for a child to be independent or respectful of their elders?

Would you say that it is more important for a child to be curious or to have good manners?

Would you say that it is more important for a child to be obedient or self-reliant?

Would you say that it is more important for a child to be considerate or to be well-behaved?

Would you say that it is more important for a child to be free-spirited or polite?

Would you say that it is more important for a child to be orderly or imaginative?

Would you say that it is more important for a child to be adaptable or disciplined?

Would you say that it is more important for a child to be loyal or open-minded?

Results

Comparing the beta coefficients of switchers on incorrect trials to the beta coefficients of stickers on incorrect trials in table 1, we see that the results do not validate our 1st and 2nd hypotheses. The betas on incorrect trials were not significantly different ($t_{1,340}$ = -0.81, p = 0.42) for stickers and for switchers, indicating that stickers integrated disconfirmatory evidence at similar levels as switchers. Similarly, the betas on correct trials were not significantly different ($t_{1,340}$ = 0.92, p = 0.36) for stickers and for switchers, indicating that stickers and switchers integrated confirmatory evidence at similar levels.

Table 1: Switcher and sticker beta coefficients

	Disconfirmatory evidence integration	**Confirmatory evidence integration**
Switchers	0.8	-0.07
Stickers	0.97	-0.13

These results indicate that being a swing voter or a sticker had no effect on the integration of disconfirmatory or confirmatory information. We ran Bayesian t-tests to quantify evidence for the absence of this effect, using the ttestBF function from the BayesFactor R package. The Bayes factors yielded by the Bayesian t-tests were 0.16 and 0.18 respectively for disconfirmatory and confirmatory evidence integration. The Bayes factors were lower than 0.33, which by convention is used as a threshold indicating that the alternative hypothesis is less likely than unlikely. This provides additional evidence for the null hypothesis, indicating that it was more unlikely than likely for there to be a difference between switchers and stickers on these measures.

As shown in table 2, contrary to our 3rd and 4th hypotheses, disconfirmatory evidence integration ($p = 0.83$, $z = 0.21$) and confirmatory evidence integration ($p = 0.21$, $z = 1.25$) were not significant predictors of switching from Trump to Biden. Conservatism ($p < 0.001$, $z = -3.94$) and authoritarianism ($p < 0.001$, $z = -4.32$) were: the more conservative or the more authoritarian 2016 Trump voters were, the least likely they were to switch to Biden in 2020. Sex ($p = 0.03$, $z = 2.19$) significantly predicted switching, with men being more likely to switch than women. This parallels the overall gain that Biden made among male voters compared to Hillary Clinton. As the Pew Centre notes, "men were almost evenly divided between Trump and Biden, unlike in 2016 when Trump won men by 11 points" (Link). Age was a significant predictor of switching ($p = 0.008$, $z = -2.67$), with older voters less likely to switch than younger voters. No level of the employment, ethnic group or educational attainment variables significantly predicted switching.

Table 2: Predictors of switching from Trump to Biden

	(1)	(2)	(3)
Disconfirmation bias	0.068	-0.099	
	(0.324)	(0.293)	
Confirmation bias	0.675		0.628
	(0.540)		(0.492)
Conservatism	-0.096 ***	-0.093 ***	-0.096 ***
	(0.024)	(0.024)	(0.024)
Authoritarianism	-0.295 ***	-0.295 ***	-0.294 ***
	(0.068)	(0.068)	(0.068)
Sex	0.736 *	0.724 *	0.741 *
	(0.336)	(0.334)	(0.335)
Employment status: Part time	0.008	0.032	0.006
	(0.506)	(0.504)	(0.506)
Employment status: Other	0.713	0.738	0.733
	(0.840)	(0.843)	(0.836)
Employment status: Unemployed	0.387	0.267	0.382
	(0.624)	(0.609)	(0.624)
Employment status: Due to start a new job	0.497	0.542	0.530
	(1.355)	(1.356)	(1.344)
Education: Technical/community college	0.313	0.293	0.318
	(0.517)	(0.514)	(0.516)
Education: Undergraduate degree	0.037	0.050	0.031
	(0.446)	(0.443)	(0.445)
Education: PhD	0.419	0.332	0.423
	(1.163)	(1.155)	(1.162)

Education: Graduate degree	0.901	0.892	0.907
	(0.529)	(0.524)	(0.528)
Education: No formal qualifications	-15.726	-15.837	-15.773
	(2399.545)	(2399.545)	(2399.545)
Ethnicity	1.227	1.255	1.205
	(1.000)	(0.999)	(0.993)
Age	-0.040 **	-0.042 **	-0.040 **
	(0.015)	(0.015)	(0.015)
N	256	256	256
null.deviance	350.881	350.881	350.881
df.null	255.000	255.000	255.000
logLik	-138.502	-139.295	-138.525
AIC	331.004	330.589	329.049
BIC	426.724	422.764	421.224
deviance	277.004	278.589	277.049
df.residual	229.000	230.000	230.000

*** p < 0.001; ** p < 0.01; * p < 0.05.

In order to validate the findings of our logistic regressions, we computed likelihood ratio tests in table 3 to compare the models with our variables of interest and the socio-demographic control variables to the models with only the control variables.

Table 3: Analyses of deviance

Model name	χ^2	df	p-value
Full Model	-38.77	-4	< 0.001
Disconfirmatory evidence integration	-0.03	-1	> 0.1
Confirmatory evidence integration	-0.84	-1	> 0.1
Authoritarianism + Conservatism	-37.07	-2	< 0.001
Authoritarianism	-20.57	-1	< 0.001
Conservatism	-15.56	-1	< 0.001

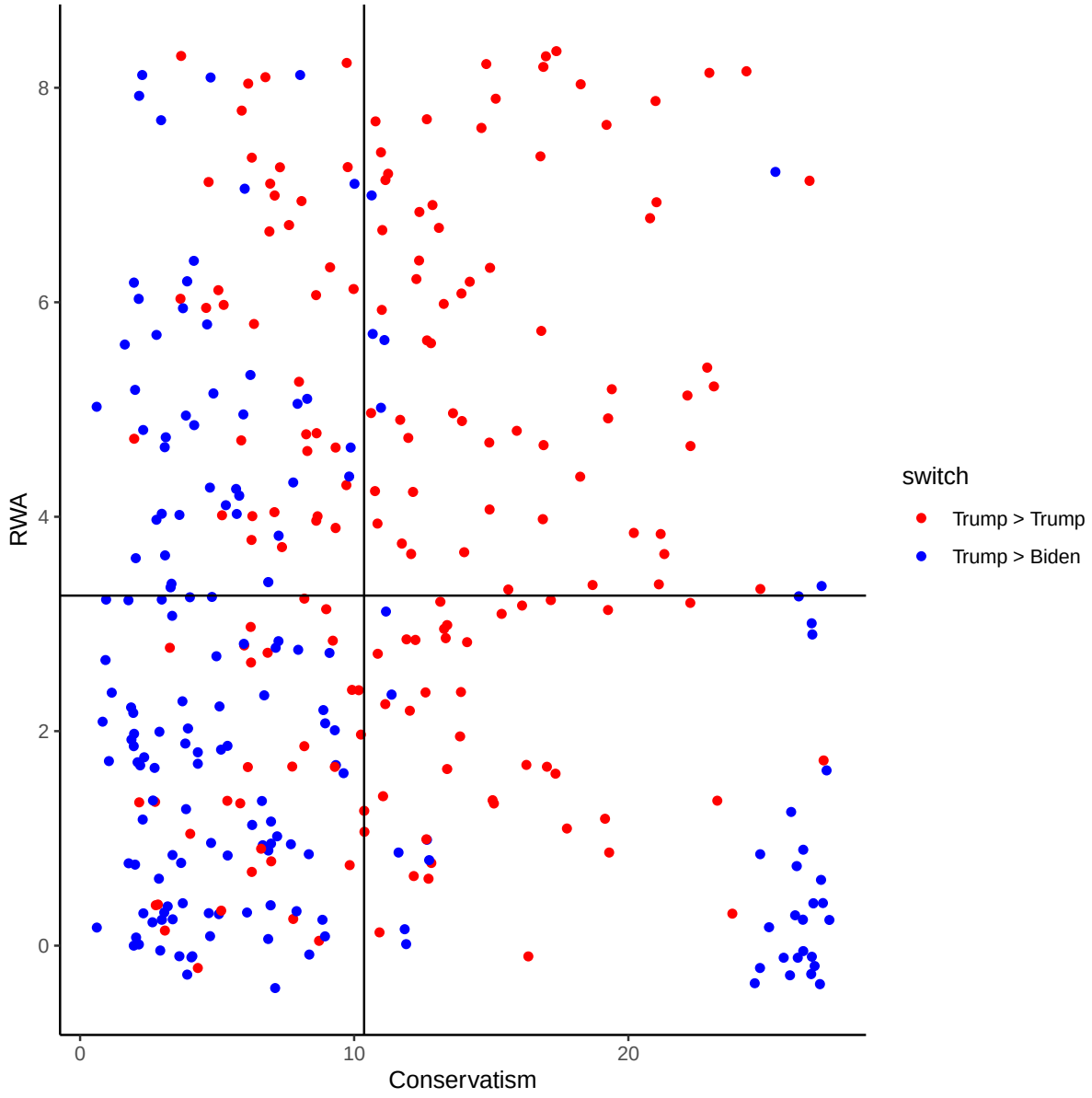
Note: all the models reported in the table include the socio-demographic control variables. The 'full model' includes all variables.

The chi-square statistics of the models that included authoritarianism and conservatism (or both) were significant. The chi-square statistics of the models that included disconfirmatory or confirmatory evidence integration (or both) but not authoritarianism and conservatism were not significant. This indicates that the additional complexity brought about by the inclusion of authoritarianism and conservatism -as opposed to the simple model with only socio-demographic variables- was warranted as it significantly reduced deviance. However, the inclusion of disconfirmatory and confirmatory evidence integration was not warranted. This confirms the findings of our logistic regression that authoritarianism and conservatism were associated with vote switching but disconfirmatory and confirmatory evidence integration were not.

We looked in greater depth into our findings relating to authoritarianism and conservatism in figure 1. We created four quadrants showing the distribution of switchers (light blue dots)

and stickers (dark blue dots) with right-wing authoritarianism (authoritarianism) as the y-axis and conservatism as the x-axis. The quadrants are divided by the mean values of each predictor. The largest group of switchers is low in authoritarianism and conservatism, in the bottom left quadrant. There are very few switchers in the high authoritarianism-high conservatism quadrant. However, we note a sizeable group of switchers who are low in conservatism but high in authoritarianism. We also note a distinct cluster of switchers in the bottom right quadrant, indicating high conservatism and low authoritarianism.

Figure 1: Switchers and stickers distributed on authoritarianism and conservatism axis



Given previous work linking authoritarianism itself with differences in belief updating we also tested whether there was any relationship between these measures. In linear models with disconfirmatory and confirmatory evidence integration as the dependent variable and authoritarianism as the independent variable, authoritarianism did not predict disconfirmatory ($p = 0.359$, $t = 0.92$) or confirmatory evidence integration ($p = 0.9977$, $t = 0.003$).

Our 5th hypothesis concerned differences in metacognitive ability. Figures 2 and 3 show the posterior distributions of metacognitive efficiency for switchers and stickers respectively. A distribution overlapping with 1 on the x axis indicates optimal metacognitive efficiency. It indicates that a participant's assessment of their own performance is the same as their objective performance. Any deviation from 1 or non-overlap indicates the contrary: participants either over or under-estimate their own performance. Values of metacognitive efficiency greater than 1 indicate overconfidence while values smaller than 1 indicate underconfidence. There is no significant difference between switchers and stickers in this regard, as the distributions are similar and not optimal.

Figure 2: posterior distribution of metacognitive efficiency values for switchers

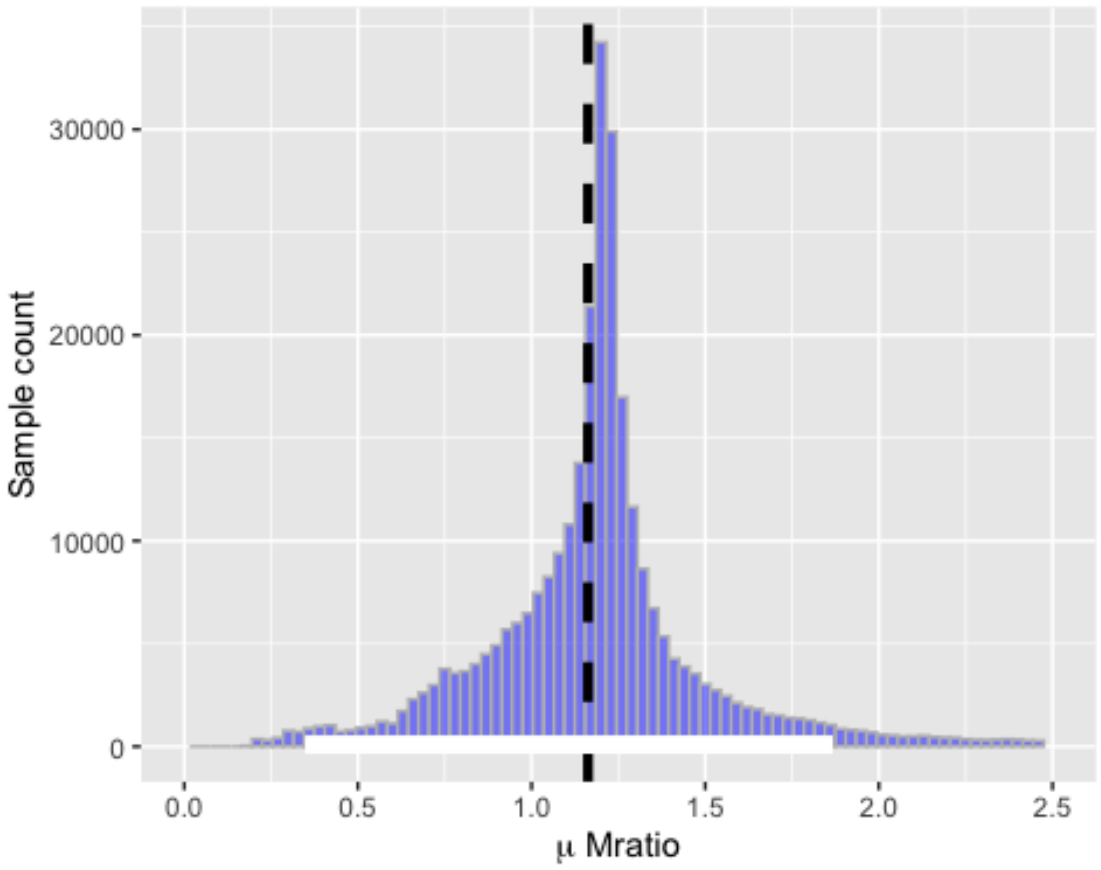
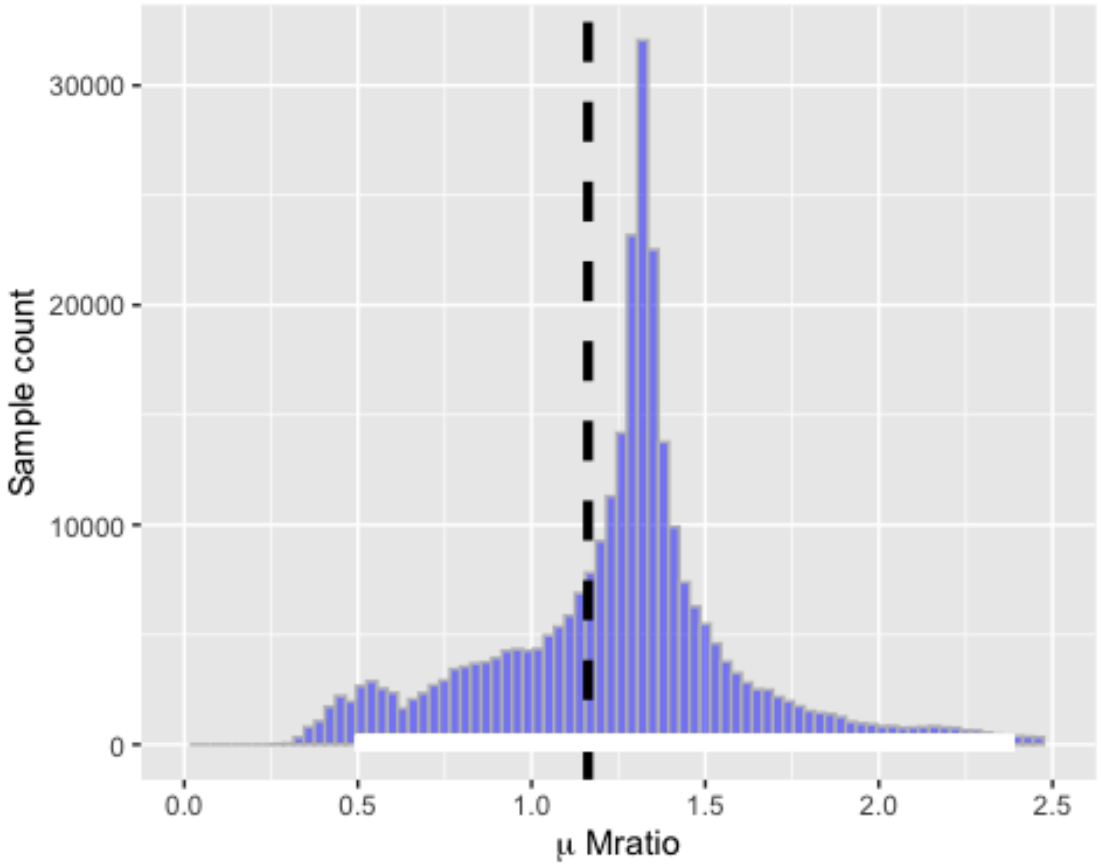
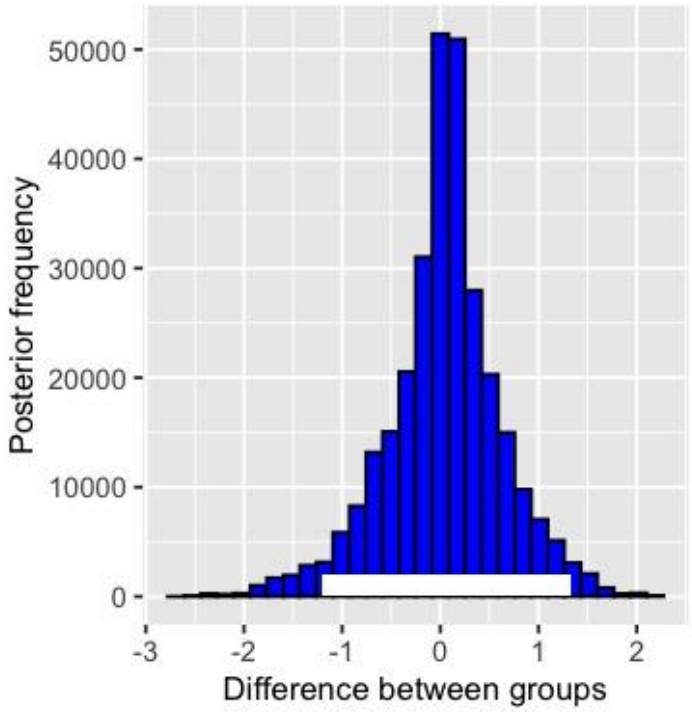


Figure 3: posterior distribution of metacognitive efficiency values for stickers



A more formal approach is to plot the difference between the posterior distributions of the group-level log metacognitive efficiencies and see if the 95% confidence interval of this distribution excludes zero. We plot this difference in figure 4 in log units with the 95% highest posterior density interval (HPDI) indicated by a white bar. The HPDI is the "narrowest interval containing the specified probability mass" (McElreath, 2015, p. 56) and constitutes the confidence interval of interest for posterior distributions. Figure 4 shows no difference between the two groups: not only does the distribution overlap with zero, the modal value of the distribution is zero.

Figure 4: Difference in metacognitive efficiency between switchers and stickers



We also looked at the distribution of confidence ratings by group and level of evidence strength to ensure that switchers and stickers presented no difference in confidence levels which are used to compute meta-d'/d'. We report these descriptive statistics in figures 5 and 6. These show that switchers and stickers presented the same confidence rating trends and had similar confidence ratings at the different levels of evidence strength.

Figure 5: Mean confidence at different levels of evidence for correct trials

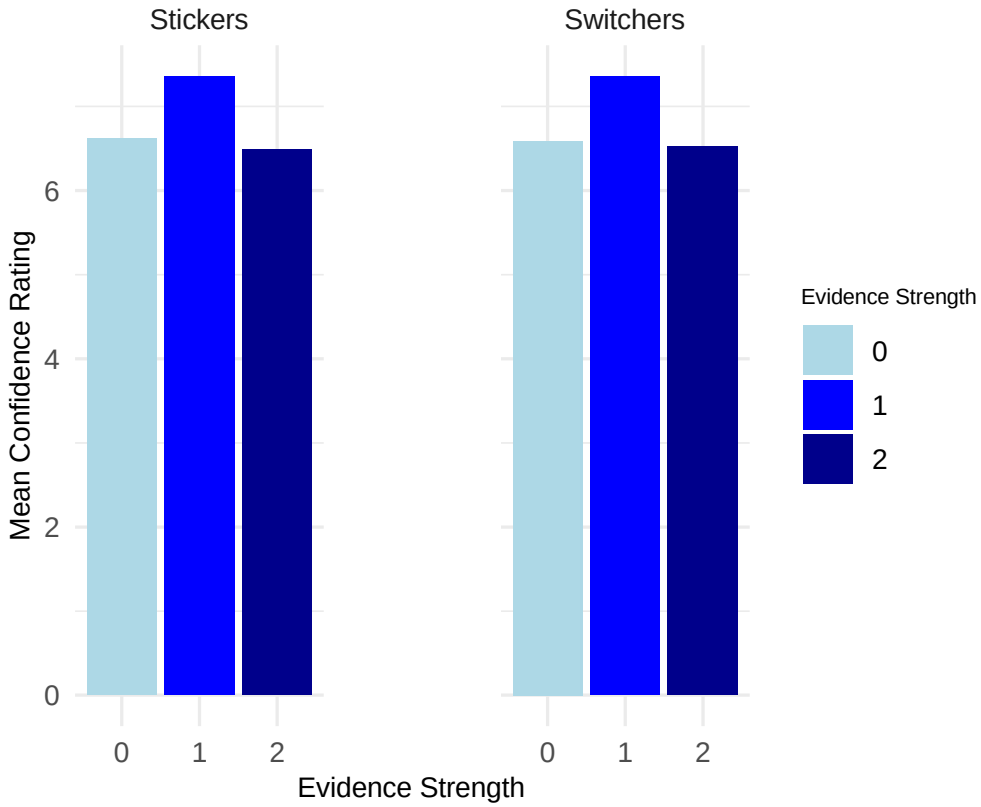
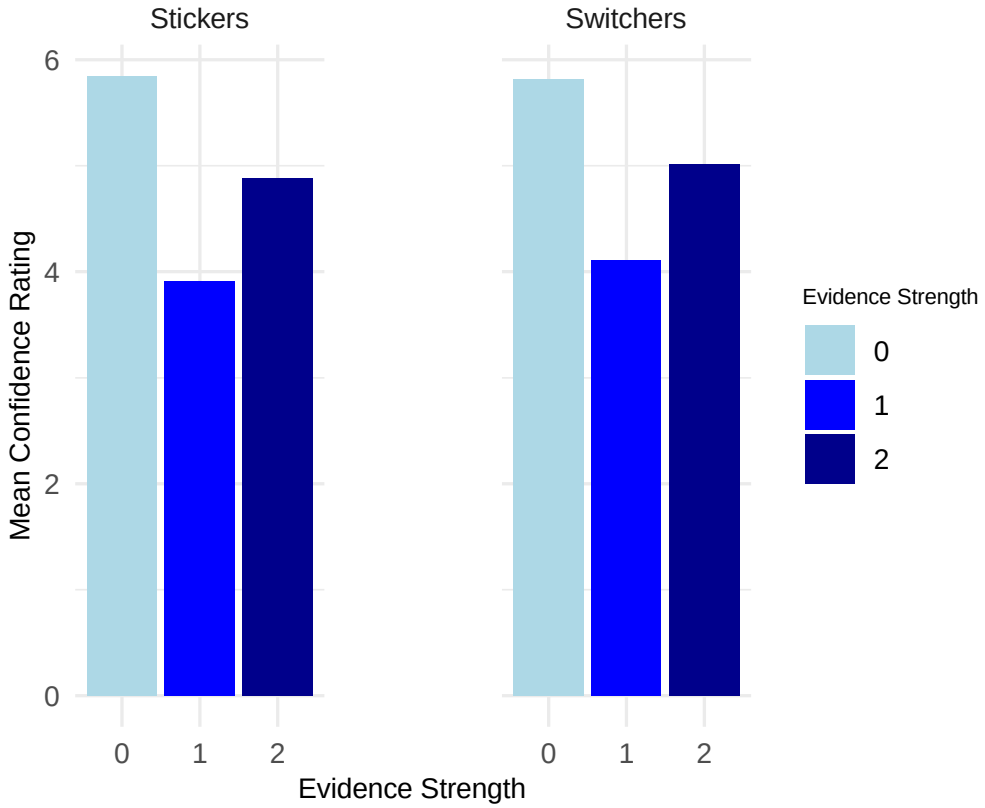


Figure 6: Mean confidence at different levels of evidence for incorrect trials



Discussion

The results did not support our hypotheses. Voters who stuck with Trump in 2016 and 2020 did not have higher confirmation bias than voters who changed their mind and switched to Biden in 2020. Trump stickers and switchers integrated confirmatory and disconfirmatory evidence in a similar way, with no significant difference in how they processed evidence. Our experiment yielded several findings of note.

First, swing voters did not appear to differ from other voters in relation to confirmation bias. Switchers were not better than stickers at integrating disconfirmatory evidence and they integrated confirmatory evidence at the same level as stickers. We hypothesised that voters could have switched from Trump to Biden because they updated their beliefs on Trump and became critical of their past decision to vote for Trump. They could have updated their beliefs in light of new information such as his record and conduct while in office. However, the evidence from our sample shows that on perceptual tasks stickers and switches do not differ in objective measures of this cognitive process.

Second, vote stickers did not present any metacognitive failure in their reasonning compared to switchers. Their confirmation bias levels and metacognitive sensitivity were similar to those of swing voters. These findings provide evidence against the “rigidity of the right” hypothesis which postulates that cognitive flexibility is related to more liberal or left-wing political opinions while cognitive rigidity is related to more conservative or right-wing opinions. The rigidity of the right hypothesis does not explain why certain voters switched while others didn’t. If it did, then switchers should have had lower confirmation bias and

higher metacognitive sensitivity than stickers, and shown greater flexibility in belief updating.

We found no significant relationship between conservatism and confirmatory or disconfirmatory evidence integration. The fact that our measures of bias and conservatism were not associated provides support against the "rigidity of the right" hypothesis. Moreover, in figure 1, in the bottom right quadrant, we noted a distinct cluster of switchers who were low in authoritarianism and scored high on the conservatism scale. This cluster shows us how strong conservative values can pull voters in different directions rather than solely sticking with their own party's candidate. This finding echoes recent work on intra-party polarisation. Looking at polarisation between and within US and UK political parties, Young and De Wit (2024) found that within-party polarisation was higher among Republican factions and even that "Republicans consistently prefer pro-bipartisanship Democrats over rival Republican factions" (p. 14). Such polarisation between Republicans who support Trump and those who don't might underlie the different voting directions that strong conservative values led to in our sample.

Trump stickers were just as good as switchers at assessing their performance on an objective task. This is a major difference with other approaches which, as argued in the introduction, found that certain political groups presented specific cognitive styles with measures that used political content (e.g. those reviewed in Jost et al., 2003). As previously stated, these approaches risk measuring the dependent variable with variables undistinguishable from it, resulting in a tautological relationship. The task we used is an objective measure of confirmation bias and metacognitive sensitivity which, by employing a perceptual discrimination task, also eliminates the possibility of any form of liberal bias in the way these

cognitive processes are measured and scored. According to our measures, swing voters were not less biased than other voters when appraising new information and assessing their past decisions, suggesting that the difference between switchers and stickers does not seem to be cognitive and appears to have more to do with values than with cognition. Trump stickers expressed more authoritarian values than switchers. Although the items of the authoritarianism scale we used are non-political, they correlate with several political attitudes.

However, it is important to note that we have measured a narrow set of cognitive processes and that there might be other cognitive processes where swing voters and other voters do differ. We also acknowledge the fact that, although our task provides a non-political, objective measure of confirmation bias, it relies on a visual perception paradigm. Cognition for stimuli more closely related to politics might have shown a difference between swing voters and other voters.

In relation to authoritarianism, our findings show that although confirmation bias and metacognitive sensitivity were not predictive of whether 2016 Trump voters would switch or not, authoritarianism and conservatism were. Authoritarianism had a greater effect on switching probability than conservatism. We saw in Figure 1 that a sizeable cluster of switchers had high scores on the conservatism scale, underscoring the fact that the overall effect of conservatism on switching probability is uncertain. In fact, we observed a higher variance in conservatism scores among switchers ($\sigma = 68.19$) compared to stickers ($\sigma = 31.38$). This suggests that having more conservative views only marginally reduced voters' probability of switching compared to having a more authoritarian personality. Differences in authoritarianism, on the other hand, had a greater effect on switching probabilities.

Authoritarianism appears to have been the main factor shaping voters' decision to switch or not.

Rollwage and Fleming (2018) found that participants with extreme radical and dogmatic beliefs displayed lower metacognitive sensitivity and reduced updating of their confidence when presented with post-decision evidence. The authors noted how the ability to change one's mind seemed to depend also on the metacognitive capacity to realise that one's beliefs were wrong, which individuals holding radical views lacked. Importantly, the authors could only account for a reduced share of variance (approximately 2%) which may have pertained to individuals holding extremely radical views. The participants in our sample may have presented no difference in metacognitive sensitivity because they were not selected on the basis of extreme radicalism or dogmatism. The belief polarisation present in our sample may have been too small to reflect differences in metacognitive sensitivity and confirmation bias.

De Beukelaer et al. (2023) had found that greater metacognitive sensitivity led individuals to have greater likelihood of updating their beliefs on climate change. In our cases, differences in metacognitive sensitivity did not account for changes in voting behaviour. This suggests that there is no fundamental cognitive difference in information processing between swing voters and other voters. The main difference between them seems to relate to their values and, more specifically, to differences in authoritarianism. Switchers and stickers could also have differed in the information they received and on the basis of which they decided how to vote (media, social media content, conversations, etc) although such an interpretation remains speculative as we did not collect data on information sources.

In summary, we found no evidence that a change in vote between 2016 or 2020 was linked to objective measures of belief updating or meta-cognition. Moreover, whilst authoritarianism was predictive of voter switching, it was also uncorrelated with objective measures of cognition. These results highlight that whilst differences in belief updating might be predictive of political extremism, and updating with regards to topics like climate change, they do not explain changes in voting behaviour between 2016 and 2020. We think this null result reinforces the need to incorporate objective measures of cognition into political psychology that do not include political content. Our results highlight that factors like values, age and sex are much better predictors of voter switching between 2016 and 2020 than measures of cognition.

***

We found that swing voters did not differ from other voters in the way they thought, at least in the cognitive processes that we examined. They were similar in their belief-updating abilities and levels of confirmation bias.

We could not identify distinct cognitive traits of swing voters, although our analysis was limited to a subset of cognitive processes. In our endeavour to find the characteristics common to swing voters that shape their reasoning and decision-making, we adopted another approach. Our second study looked at voters' insight into their own decisions or, in other words, at their consciousness of their own decisions. However, some of the influences that shape political decision-making, as we argued in the Introduction, are not conscious. These include the somatic markers with which our body signals an instant leaning towards one option rather than the other and instant, implicit judgments that the brain makes.

Neuroscience offers a broad array of measures with which we can assess these non-conscious influences on beliefs and behaviours, many of which have been employed in consumer neuroscience. Such measures include physiological indicators such as eye tracking, where studies have shown that eye movements interact with consumers' goals when watching advertisements or learning about brands (Pieters et al., 2007). They also include several applications of EEG, both in ERP and spectral analysis research. For example, the Frontal Alpha Asymmetry (FAA), which reflects greater left frontal activation in the alpha band, has been used as a proxy of approach (as opposed to avoid) behaviour (Davidson, 1998) and to predict consumers' decisions to purchase a good (Ravaja et al., 2013).

Following this line of research, we explored whether there could be neural correlates of swing voting, leveraging the insights and methods offered by the relatively new field of neuro-politics.

Author contribution statement

Emmanuel Mahieux designed research, carried out data collection, data processing, statistical analyses, generated figures and wrote different versions of the manuscript. Lee De Wit designed research, provided feedback and edited successive versions of the manuscript. Joe Devlin designed research and edited the manuscript. The experiment was originally designed by Stephen Fleming and transposed into an online experiment in Gorilla.sc by Max Rollwage. Code for estimating metacognitive sensitivity was written by Stephen Fleming, Max Rollwage, Audrey Mazancieux and Oliver Warrington.

Chapter 3 - Neural correlates of swing voting: can we predict the undecided vote with neural measures?

Introduction

The former Downing Street head of communications Alastair Campbell once commented that polls hide a complex process. Individual voters make up their minds for one party or the other for a myriad of reasons. The political science and psychology literature has explored how factors that voters are themselves aware of might influence their vote, such as ideology (Conover et al., 1981) or how much voters say they personally like one candidate over the other (Weisberg et al., 1970; Brody et al., 1973).

However, research suggests that voters are not always conscious of all the reasons why they vote and that subconscious factors of voting behavior can affect cognition. Subconscious influences on voting behavior can make voters in situations of fear more likely to choose political leaders with facial features associated with trustworthiness (Tsakiris et al., 2021). Cognitive dissonance, the psychological need to be consistent in our behavior and beliefs (Festinger, 1957; Sorace et al., 2021), can have a powerful influence on how people vote. Voters who voted for the party in power will perceive the economy as doing better than those who voted for the party in opposition (Evans et al., 2006; Evans et al., 2010), which in turn makes them more likely to vote again for the same party.

Because some factors shaping voting behavior are not conscious, and therefore not explicit in voters' attitudes and beliefs, measures of implicit preference offer considerable promise in shedding light on voting behavior and its underlying cognitive processes. Event-related potentials (ERPs) may offer a measure of this kind of unconscious processing which is unlikely to be biased by any of the demand characteristics shaping verbal reports or behavioral data. ERPs are scalp-recorded, continuous measures of electrical brain activity that provide a window into the unfolding cognitive processes that lead to a behavior. Galli et al. (2017, 2021) proposed that the N400, a well-studied ERP component (Kutas et al., 1980), could be used as a new measure of implicit political preferences.

The N400 is a negative-going voltage deflection that peaks around 400 ms after stimulus onset and is largest over centro-parietal sites with a slight right hemisphere bias for written words. It is part of the normal response to stimuli that will produce some activity in long-term semantic memory (Federmeier, 2022). In other words, the N400 is a response to any meaningful or potentially meaningful stimulus and is larger in amplitude when words (or concepts) are inconsistent with expectations based on context or with internal beliefs/knowledge (Kutas et al., 1980; Kutas et al., 2011). The N400 is an indicator of semantic processing with the size of its effect varying with the degree of semantic deviation. The N400 effect is the difference obtained from subtracting ERPs for two conditions. For example, the ERP generated by expected stimuli subtracted from the ERP generated by unexpected stimuli could be referred to as an N400 effect of expectancy. For example, "I drink my coffee with milk and ***socks***" will generate a greater ERP response at the word "socks" than reading "I drink my coffee with milk and ***sugar***" (Kutas et al., 1980).

The N400 has also been found to occur in instances where moral or political expectations are violated. In these instances, the N400 has been hypothesized to be a marker of implicit moral and political preferences. Van Berkum et al. (2009) found that strict Christians and non-Christians had opposite N400 responses when viewing statements on societal issues such as euthanasia, abortion and homosexuality. Notably, participants' N400s were greater when reading statements they disagreed with than when reading statements they agreed with. For example, strict Christians had larger N400 responses when reading "I think euthanasia is an ***acceptable*** course of action", which is inconsistent with their moral values, than when reading "I think euthanasia is an ***unacceptable*** course of action". The idea formulated by Van Berkum et al. is that any concept stored in semantic memory has an affective tag attached to it, which will mark it with positive or negative valence when retrieving its meaning.

Galli et al. (2017, 2021) also found evidence supporting the claim that violations of moral or political expectations elicit the N400. In the weeks preceding the 2016 EU referendum in the UK on whether to leave the European Union or remain in it, Galli and her colleagues compared the N400 to key words in political statements between decided and undecided voters. These political statements were centred around attitudes towards the EU, for example:

"If Britain leaves Europe our quality of life will be **enhanced/reduced.**"
"Free access to healthcare for all EU migrants should be **denied/allowed**."

Consistent with Van Berkum et al. (2009), they observed that decided Leave voters had greater N400 responses when reading pro-Remain statements, while Remain voters had the inverse pattern with greater N400 responses when reading pro-Leave statements. Critically, they found that the N400 effect predicted the vote of both decided and undecided voters above and beyond

a measure of explicit preference as measured by a self-report index (SRI). The N400 effect and SRI were computed from the same statements.

Galli et al. (2021) reimplemented this paradigm at the 2019 European parliamentary elections in Italy. They examined whether the N400 effects generated by separate political issues, namely economic, anti-establishment and cultural issues, were predictive of voter behavior in mainstream versus populist voters. The statements expressing these political issues included, for example:

"I think immigration from non-EU countries is a great **opportunity/problem**.
The effects of globalisation on the employment rate are **positive/negative**.
In my opinion, the majority of our politicians is **trustworthy/untrustworthy**."

They also tested how this measure compared with another measure of implicit political preference - the implicit associations test, IAT (Greenwald et al., 1998) - and with an explicit measure of political preference - an SRI which in this case too was computed using the same statements the N400 was derived from. The N400 was larger in amplitude for statements on economic issues that were inconsistent with participants' political attitudes but was not different between groups for anti-establishment and cultural issues. They also found that the N400 for statements on economic issues was significantly predictive of vote choice as a standalone predictor, although not above and beyond the explicit measure of political preference, while the IAT was not. Moreover, the model that included both the SRI and the N400 effect as predictors was better at predicting vote choice than the model with only the SRI. Their findings suggested that political preferences on economic issues, which have traditionally

been useful predictors of voting behavior (Nadeau et al., 2001; Lewis-Beck et al., 1984; Abramowitz, 2008), remained a key factor shaping vote choice.

Morris et al. (2003) also found that the N400 could be used as a marker of implicit disagreement and preferences in political cognition. They analysed the N400 responses of participants reading political primes paired with positively or negatively valenced target words. The political primes consisted in the names of known political figures or political concepts such as "Clinton", "Republican" and "Pro-choice" while the targets consisted in positively or negatively valenced adjectives such as "honest" and "vulgar" (e.g. "Republican – Honest"). Before the EEG experiment, participants indicated which political primes they rated as "positive" and which they rated as "negative" in order to determine which primes were affectively congruent or incongruent for each participant. During the EEG experiment, the responses to each prime-target pair was analysed. To clarify, the ERP to the prime was not analysed separately from the response to the target. They found that prime and target pairs of political attitude objects elicited greater negativities in the N400 latency range when the prime and the target were affectively incongruent compared to when they were congruent. The authors interpreted these results as suggesting that "the emotional valence of a political prime is stored along with the concept itself, and that an affective response becomes active upon mere exposure to the political stimulus" (Morris et al., 2003, p. 1) and underlined the potential of ERPs in measuring the activation of implicit attitudes.

To summarize, we currently know several aspects about the relationship between the N400 and political behavior: 1) The N400 response is greater for political or moral statements that are inconsistent with our beliefs and in this way can act as an implicit measure of disagreement. 2) The difference in the N400 response across political groups aligns with political beliefs, for

example with Leave and Remain voters presenting opposite N400 effects to the same political statements. 3) In Galli's 2021 study, mainstream and populist voters had similar responses to statements on anti-establishment and cultural issues. They differed only in their responses to statements on economic issues. Thus, not all political stimuli generate different N400 responses in different political groups, despite their explicit preferences. 4) Based on Galli's findings, the N400 effect appears to improve the predictive ability of models with explicit measures of political preference by accounting for some of the variance in voting behavior that these measures do not account for.

Our study aimed to add to this existing knowledge in two ways. First, we tested if the N400 effect was predictive of vote choice in a different, highly polarized electoral context in the United States, using an adaptation of Galli et al.'s N400 paradigm. Should the N400 effect to political statements align with vote choice in decided voters, we can use this implicit measure of political preference to predict undecided voters' vote choice retrospectively. We sought to compare the ability of these implicit measures and that of explicit measures of political preference in predicting vote choice.

The Texas 2022 gubernatorial election in San Antonio provided an ideal political environment to test this. Texas has been a Republican-led state since 1995 within which the district of San Antonio is a Democratic enclave. The gubernatorial election took place two years after Democratic president Joe Biden's election to the presidency and less than five months following the Supreme Court's decision to reverse Roe v Wade, a landmark ruling that had enshrined a woman's right to abortion since 1973. Moreover, the incumbent Republican governor of Texas, Greg Abbott, who was seeking re-election, had recently signed Senate Bill 8 of the Texas legislature, better known as the "heartbeat bill", which banned abortions after

the first six weeks of pregnancy, making abortion a salient issue in the political debate. The Democratic candidate, Beto O'Rourke, opposed this measure (Dey, 2022). Moreover, the political climate was marked by an immigration crisis with high numbers of immigrants crossing from Mexico into Texas which the state government blamed the federal government for (Aguilar, 2021).

Thus, the political climate of San Antonio and Southern Texas in the weeks preceding the election made fault lines between the two parties and their candidates particularly salient. It provided the ideal setting to test whether the N400 effect could reflect the differences in political preferences between Republicans (right leaning) and Democrats (left leaning) similarly to what was observed between Leave and Remain voters in the UK, and populist and mainstream voters in Italy. If the N400 effect is a marker of implicit disagreement, it should reflect political differences between opposing sides and be a strong predictor in a highly polarized political environment.

Consider the statement, *The ownership of automatic assault weapons like AR-15s needs to be* ***restricted/protected***. Based on Galli et al's findings, if voters hold pro-Democrat or pro-Republican views, they should have a larger N400 response when reading the target word that runs contrary to their beliefs. Democratic participants should have more negative-going responses to Republican **(*protected*)** than Democratic statements (***restricted****)*, and vice-versa. We hypothesized that the N400 effect would constitute an implicit measure of political expectations and beliefs at the target word. In turn, our goal was to determine if the N400 effect derived from reading the target words was predictive of vote choice in undecided voters.

Second, in addition to measuring implicit political preferences with the N400 effect, we used another implicit predictor of voting behavior: namely a recently revised measure of authoritarianism by Engelhardt et al. (2023) that focuses on child-rearing values with no explicit reference to politics. Authoritarianism is a "personality adaptation that values social cohesion and conformity to in-group norms over personal freedom and individual autonomy" (Engeldhardt et al., 2023, p. 4). Authoritarianism was used as a factor along with the N400 effect in a model of vote behavior to further test how implicit, non-political measures of political preference compared with explicit measures of political preference in their ability to predict vote choice. Authoritarianism has been a good predictor of voting for Trump and other far-right leaders in the past years (Stenner et al., 2018). Authoritarianism is also a correlate of several factors that influence political beliefs and voting behavior, such as attitude towards outgroups (Duckitt, 2006), race and gender (Sibley et al., 2006) and political alignment with the far-right (Sibley et al., 2008). Stenner and Haidt (2018) found that in situations of high normative threat, the probability for voters with high authoritarianism scores of voting for a far-right candidate in the US or France was respectively 87% and 84% compared to 7% and 11% for voters with low authoritarianism scores.

We examined whether authoritarianism could also explain divides in our sample of the US electorate. The ability of measures of extreme-left attitudes to predict the kind of voting behavior we are interested in has not been tested, to our knowledge, contrary to authoritarianism, which motivates our choice to use the latter but not the former. We used two measures of authoritarianism: Engelhardt et al.'s (2023) child-rearing values scale and Bizumic's (2018) very short authoritarianism scale (VSAS). Stenner (2005) and Engelhardt et al. (2023) developed a measure of authoritarianism that constitutes an implicit measure of political preferences. It relies on asking participants which values they consider most important

in raising children, for example if it is more desirable for a child to be curious or to have good manners. It is considered an "implicit" measure of political preferences because it measures an attitude (authoritarianism) that underlies political preferences rather than an explicit agreement or disagreement with political preferences.

The advantage of using the child-rearing values scale is that it reliably measures authoritarian attitudes and their political correlates without using wordings that are explicitly political, thus avoiding the risk of the dependent and independent variables being indistinguishable and allowing us to test the predictive potential of implicit authoritarian attitudes. This risk of the dependent and independent variables being endogenous can occur when predictors attempt to explain political attitudes and behaviors (e.g. vote choice, policy preferences) with other political attitudes and behaviors (e.g. self-placement on a left-right scale, right-wing authoritarianism scale) which constitute the same phenomenon.

In addition to the implicit child-rearing scale by Engelhardt et al., we included an explicit measure of authoritarianism in order to compare their respective abilities to predict vote choice. We thus included Bizumic's VSAS which uses Likert ratings to measure authoritarianism with explicitly political statements, such as "What our country needs most is discipline, with everyone following our leaders in unity".

We tested whether our implicit measures of the N400 effect and child-rearing values scale predicted vote choice. We predicted that the N400 effect would reflect the differences in explicit political preferences between decided Republicans and decided Democrats in the same way that it reflected differences between voters in the UK and Italy. The N400 effect should align with political preferences, with larger N400 amplitude for target words that are

inconsistent with political preferences compared to target words that are consistent with them. Thus, we predicted that Democrats should have more negative-going N400 amplitudes for pro-Republican compared to pro-Democratic target words whereas Republicans should have more negative-going N400 amplitudes for pro-Democratic compared to pro-Republican target words. We further tested this hypothesis for different political issues – the economy, immigration and societal issues- to see if we could replicate Galli et al.'s (2021) findings on political-issue related N400s. We hypothesized that if the N400 effect aligned with vote choice in decided voters, it would predict undecided voters' vote choice above and beyond explicit measures, in line with Galli et al.'s 2017 findings. We also predicted that our implicit measure of authoritarianism (the child-rearing scale) would be a better predictor of voting choice among all voters than the explicit measure of authoritarianism (the VSAS).

The current study replicates and extends the N400 studies conducted in Europe to a young adult population in the US during a highly polarized political period. By using a multi-measure approach (e.g. neural, behavioural and survey data), together these findings contribute to the neuro-politics literature by examining how different implicit and explicit measures of political preference impact vote choice.

Methods

Experimental procedure

Participants. The study took place at the University of Texas at San Antonio (UTSA) in the weeks preceding the 2022 Texas gubernatorial election, from 14th October to 10th November 2022. The study received IRB approval for research with human participants (protocol FY21-

22-345) from UTSA's Institutional Review Board. All experiments were conducted in accordance with IRB guidelines and regulations and informed consent was obtained from all participants.

We recruited 55 participants among undergraduate students registered to vote and planning to do so (Female = 32, Male = 22, Non-binary = 1). UTSA students' racial and ethnic backgrounds (Hispanic or Latino = 59%, White = 21%, Black or African American = 8%, Other = 12%, source: UTSA, 2022) reflect the proportions in the general South-central Texas population. The average age was 20 years (SD = 2.4 years). All participants were right-handed, with normal or corrected to normal vision. Among the participants, 20 had decided to vote for the Democratic candidate for state governor, 18 for the Republican candidate and 17 were undecided as to who to vote for. We aimed to have similar group sample sizes to those of Galli et al. (2017), which had approximately 20 participants per condition. We achieved similar numbers of decided Democrats, decided Republicans and undecided voters by advertising the study across the UTSA campus. Data collection of undecided voters was prioritised as their data had to be collected before they cast their vote.

Voting intention was used in the pre-screening to determine eligibility for the study. Vote intention was coded as a Likert scale with Democrat = 1 and Republican = 5 and had five possible answers: Democrat, Leaning Democrat but not sure, Undecided, Leaning Republican but not sure and Republican. Although Texas effectively is a two-party system, there are other party affiliations such as the Libertarian and Green parties (Texas governmnent, 2024). The Libertarian party promotes a political vision based on individual liberty which has endorsed both economically conservative and, on certain issues, socially liberal policies such as opposing the imposition of income tax and supporting gay marriage. Participants who intended

to vote for another party than the Republican or Democratic party were not eligible for the study as the study paradigm could only predict binary outcomes. We also collected partisan identity data and voting history. Over 75% of participants (42 out of 55) were first-time voters so voting history could not be used effectively.

We recorded participants' gender and race/ethnicity. Participants were asked to select all ethnic categories that applied, leading to 9 different factorial levels. We chose to include race because it is typically used in US elections to characterize different electorates.

Of the 55 participants in our study, 31 cast a vote for the Democratic candidate for governor and 24 for the Republican candidate. EEG and behavioral data were collected prior to participants casting their ballot, starting 25 days before the vote and up to the day of the vote itself (November 8th). Five decided Republican voters' data were collected after they cast their ballot with the goal of having equally sized samples across groups. These additional data were collected after they had cast their vote because we ran out of time to collect data from decided Republicans before the election and it was essential to have comparable sample sizes among decided Republicans and decided Democrats. However, the fact that they had already voted did not affect the validity of their data because their N400 effects were used to validate the link between the N400 effect and their explicit preferences rather than to predict their vote.

Among Democratic voters, 20 were decided at the time of the experiment on who to vote for before the election while 11 were undecided. Among Republican voters, 18 were decided and 6 undecided. Participants' vote choice for Texas governor was obtained by following up with participants by email or phone in the days following the November 8th election.

Predictors. We aimed to determine whether the N400 effect is a significant predictor of voting behavior and how it compares to other predictors. For this reason, we tested the ability of different neural, political, behavioral and demographic variables in predicting participants' vote for governor. We inserted each of these variables as the single predictor of a logistic regression predicting vote choice. We describe each of these predictors in turn.

Implicit measures of political preference included authoritarianism as measured by the child-rearing values scale, the overall N400 effect and the N400 effects for each issue dimension (economy, immigration, societal). Explicit measures included the VSAS, perception of the economy, the president's job approval, the most important problem facing the country, political knowledge and an Explicit (political) Preference Index (EPI). We explain the N400 effect and EPI measures together with the ERP experimental materials below.

The **child-rearing values score** (Engelhardt, 2023) constitutes a measure of authoritarianism. The child-rearing values scale was assembled by showing respondents pairs of values which are desirable for children to be raised with. Respondents were asked to say which value in each pair they thought was more important for a child to have. These pairs are:

- independent or respectful of their elders?
- curious or to have good manners?
- obedient or self-reliant?
- considerate or well-behaved?
- free-spirited or polite?
- orderly or imaginative?
- adaptable or disciplined?

- loyal or open-minded?

A participant's score was computed by subtracting the number of authoritarian responses from the number of non-authoritarian responses. The advantage of the child-rearing values scale is that it is a proven proxy of authoritarianism despite being exogenous to political attitudes.

The **very short authoritarianism score** (Bizumic, 2018), in contrast to the child-rearing values score, is an explicit measure of an individual's propensity to authoritarianism. It captures the different facets of authoritarianism that have traditionally been measured with the longer Right-Wing Authoritarianism scale (Altemeyer, 1981) but does so with a reduced set of statements. It was assembled by asking respondents the extent to which they agreed or disagreed with the following statements:

- It's great that many young people today are prepared to defy authority.
- What our country needs most is discipline, with everyone following our leaders in unity.
- God's laws about abortion, pornography, and marriage must be strictly followed before it is too late.
- There is nothing wrong with premarital sexual intercourse.
- Our society does NOT need tougher government and stricter laws.
- The facts on crime and the recent public disorders show we have to crack down harder on troublemakers, if we are going to preserve law and order.

Economy perception. We asked participants "thinking about the nation's economy, how would you rate economic conditions in the country today?", using the wording of the Pew Research Institute. Perceptions of how the economy is doing have long been a bellwether for

voting intentions (Nadeau et al., 2001; Lewis-Beck et al., 1984; Abramowitz, 2008), with the assumption that voters tend to hold the incumbent president or/and the party in power responsible for the state of the economy.

President's job approval. We asked participants to indicate whether they approved or disapproved of Joe Biden's job as president.

The most important problem facing the country. Polling agencies ask respondents to indicate what for them is the most important issue facing the country. Responses to such surveys are used to analyze public opinion ahead of elections (Pasek et al., 2010). We borrowed the wording of this question from the political polling and analytics company Gallup that has well-established methodologies for analyzing public opinion:

Which of the three issues below do you think is the most important problem facing the country today?

- the Economy
- Immigration
- Societal issues (abortion, race relations, gun rights)

Political knowledge was measured with a questionnaire (Pew, 2020) designed by the Pew Research Centre.

Our dependent variable was participants' **vote choice for Texas state governor**. This factor variable had two levels: Democrat or Republican. Data for this variable were collected after participants had effectively cast their vote.

Materials. The stimuli included 184 statements that were each 11 words in length. A minority of these words included contractions, apostrophes or hyphens (e.g. "Abbott's", "covid-19"). Stimuli consisted of political statements on the issues most important to Texan voters. These were determined on the basis of the issue tracker of the University of Texas at Austin's Texas Politics Project (https://texaspolitics.utexas.edu/) which indicated three political issue dimensions as being the most important for Texas voters: the economy, immigration and societal issues (i.e., gun rights, abortion, Black Lives Matter, fairness of elections). Certain statements did not fall in any of these issue dimensions and were included in a general issue category which counted towards the overall N400 effect but not towards issue-specific N400 effects.

Each statement ended with a target word that made the statement pro-Democrat or pro-Republican. There were thus two versions of 92 statements for a total of 184 statements which are included in the Supplementary Information. All participants saw both versions of all statements. There were 46 statements pertaining to the Economy, 36 statements pertaining to Immigration and 56 statements pertaining to Societal issues. The uneven number of statements for each issue dimension was mainly due to the fact that issues like the economy and societal issue are broader than immigration and allowed for a greater number of statements to be generated. The statements were divided into two blocks (A and B), with each block containing only one version of each statement. Block B had the opposite endings than block A.

In order to avoid order effects, statements were pseudo-randomised and block order was alternated across participants. This was done by randomizing statement order and adjusting it so that there would not be more than 2 consecutive Democratic or Republican statements throughout the experiment. We subsequently ran an ANOVA with block order as between-subject factor to check whether there was any difference in N400 amplitude between participants who were shown A and then B versus those who were shown B then A. The main effect of block order was not significant, indicating that N400 amplitude did not differ according to block order.

Participants were shown 10 practice trials (the same for all participants) to familiarize them with the task. A full list of the 184 statements used is included in the supplementary information. Examples of the statements include:

- Immigration: We see an immigration crisis because of the policies of ***Biden/Abbott***.

- Societal: The decision to interrupt a pregnancy is something up to ***God/women***.

- Economy: The Democrats' economic agenda will lead the US economy to ***growth/recession***.

- General issue: The people who stormed the Capitol on January 6th were ***patriots/thugs***.

The wordings of the statements were adapted from statements of the 2020 American National Election Study User Guide and Codebook (ANES, 2020) and from declarations of the Democratic and Republican candidates for governor so that they would be identifiable as pro-

Republican or pro-Democrat. To ensure that statements reflected identifiable partisan views, they were pre-tested by a random sample of 15 Democratic and 15 Republican Texas voters recruited on Prolific who were asked to indicate whether each stimulus reflected the views of the 1) Republican party, 2) the Democratic party, 3) neither of the two parties, 4) both parties or if they 5) didn't know. Only statements that were indicated by over 70% of testers as reflecting the views of the Republican or Democratic party were included in the study.

Explicit preference behavior. Participants assessed each statement through a button-press to state whether they agreed or disagreed with each statement. The **Explicit Preferences Index** (EPI) constituted an explicit measure of political preferences and was measured during the ERP experiment when participants explicitly stated whether they agreed or disagreed with each political statement. We borrowed the methodology for calculating the EPI from the Kelley index (Kelley, 2016), to quantify the degree of agreement of each participant with the Democratic or the Republican party platform. It is calculated in the following way:

EPI = (% Republican statements agreed + % Democratic statements disagreed) – (% Republican statements disagreed + % Democratic statements agreed)

Similar to the N400 effect, more positive values indicate greater agreement with Republican views while more negative values indicate greater agreement with Democratic views. A score of 200 would indicate perfect alignment with the Republican party while a score of -200 would indicate perfect alignment with the Democratic party.

Procedure. Upon arrival, participants were asked to fill in a consent form and screened for covid-19 symptoms. They also completed a questionnaire on their educational attainment, age

and socio-demographic background before or after the EEG session. They completed a questionnaire on their voting history, political knowledge, party affiliation, voting intentions, child-rearing values, authoritarianism score, perception of the state of the economy and their approval of the current president before the EEG session.

Participants were fitted with an EEG cap and sat in front of a computer screen on which the stimuli were displayed. Ten practice trials preceded the main experiment and were not repeated afterwards. Words in black font were shown one at the time at the center of a white screen using Paradigm, a stimulus presentation software with an EEG integration (http://www.paradigmexperiments.com). The lights inside the recording chamber were dimmed. Trials began with a "+" sign fixation mark for 1000 ms, and then each word appeared for 200 ms, followed by a 300 ms blank screen. This rapid serial visual presentation allowed participants to read with as little eye movement as possible to prevent ocular artifacts from contaminating the EEG signal of interest.

The final target word was presented for 1000 ms, followed by a screen asking participants if they agreed or disagreed with the statement. When participants made their agree or disagree response, the sentence-final word was no longer on the screen. To move to the next screen, Participants responded with a button press on a Playstation joystick. The response button that indicated agreement or disagreement was counterbalanced across participants.

EEG recording and pre-processing. EEG was acquired with a 26-electrode setup in geodesic array (Electrocap Inc). The array is shown in Supplementary figure S9. EEG signals were amplified using a BioSemi ActiveTwo bioamplifier (https://www.biosemi.com/products.htm). External electrodes were placed on the outer canthi and under each eye to capture horizontal

eye movements and blinks, respectively. All electrode offsets were kept under 20 millivolts. The data were sampled at 256 Hz (2048 Hz with a decimation factor of 1/8) and with a fixed first order analog antialiasing filter (-3 dB at 3.6 kHz).

Offline pre-processing and analyses were conducted using EEGLAB, ERPLAB and RStudio. The reference was set after data acquisition to the average of two electrodes placed on each mastoid. Data were filtered between 0.1 and 30 Hz. Data were segmented into epochs surrounding each target word, starting 100ms before target word onset and ending 600ms after.

Artifact-free epochs were obtained by removing components associated with blinks and horizontal eye movements through independent component analysis (ICA, Delorme et al., 2004; Delorme et al., 2007). Following ICA, epochs were inspected visually for eye movements and drifts to determine individualized thresholds. Automatic artifact rejection algorithms were applied to exclude epochs that did not meet these thresholds. Two Butterworth digital filters were applied to the data: a high-pass (low-cutoff) filter at 0.1 Hz and low-pass (high-cutoff) filter at 30 Hz. N400 waveforms were computed by averaging artifact-free epochs surrounding the statement-final target word as a function of statement type (pro-Democrat vs pro-Republican statements) and political issue dimension (economy, immigration, societal).

Participants with no fewer than 14 artifact-free epochs in the relevant conditions were retained for analyses. Five participants fell beneath the 14-trial threshold and were excluded from the computation of issue dimension-specific N400 effects. Of these, 3 were decided Republicans, 1 was a decided Democrat and 1 was undecided. On average, participants had 86 valid trials for Republican statements (range: 40-92) and 87 valid trials for Democratic statements (range: 39-92). For Economy issues, participants had 22 valid Republican (range: 18-23) and 22

Democratic trials (range: 21-23); for Immigration issues, 17 Republican (range: 14-18) and 17 Democratic trials (range: 16-18); for Societal issues, 26 for Republican (range: 22-27) and 27 Democratic statements (range: 23-30).

EEG Analyses. To determine the onset of the effect of interest, the average peak latency of the N400 was calculated across all trials and all participants to determine the time window considered for statistical analysis. The N400 latency was established as the time at which the ERP difference between Republican and Democratic statements was maximal in the 250 - 600 ms period (to exclude the early visual potentials). The N400 peaked at 378ms. The measurement window for the statistical analyses was centered around this peak value: 278 – 478 ms for all contrasts.

The overall N400 effect is the difference between the mean amplitude measurements post target word for all Republican statements minus all Democratic statements. These include statements on all issues: the Economy, Immigration, Societal Issues and general issue statements. The electrodes that displayed the greatest N400 effect were collapsed to compute these mean amplitude measurements.

N400 effects were calculated by subtracting the amplitudes for Democratic statements from those for Republican statements for each participant. Conceptualized this way, more positive values indicated greater agreement with Republican views while more negative values indicated greater agreement with Democratic views. Voters with a Republican leaning should show larger N400 responses to Democratic rather than Republican statements, resulting in positive N400 effects. The reverse was expected for voters with a Democratic leaning. In

addition to the overall N400 effect, separate logistic regressions were run with the N400 effect corresponding to each separate issue dimension (Economy, Immigration, Societal).

ERP data analysis plan. Our ERP data analysis plan was threefold. It comprised 1) an omnibus mixed model ANOVA to test whether an N400 response occurred, 2) a series of logistic regressions to compare the predictive ability of our different implicit and explicit predictors and 3) a series of likelihood ratio tests to test whether the inclusion of ERPs to predictive models increased their predictive power.

We conducted an omnibus mixed model ANOVA with Vote Choice (two levels: Democrat, Republican) as a between-subjects factor and within-subject factors of Statement Type (Democrat, Republican), Issue Dimension (Economy, Immigration, Societal), and Electrode (26 levels). We carried out separate, follow-up ANOVAs for each group and Statement Type as part of an exploratory analysis. Analyses were implemented in R using the afex package which applies the Greenhouse-Geisser correction in case of violations of the assumption of sphericity. The post-hoc tests we used are pairwise t-tests run on every combination of the different factor variables. We applied the Benjamini-Yekutieli correction to the post-hoc t-tests' significance levels. The ANOVA allowed us to test our hypothesis that the N400 effect aligns with political preferences and voting choice. We tested this by seeing whether the ANOVA showed a significant three-way interaction between Vote Choice (i.e. group), Statement Type and Electrode.

The logistic regressions and likelihood ratio tests allowed us to test our hypothesis that implicit measures of political preference are better predictors of undecided voters' vote choices than explicit measures. We tested this hypothesis by seeing which variables were significantly predictive of voters' voting choice.

We conducted likelihood ratio tests to examine whether adding the N400 effect to models with measures of explicit political preference improved their ability to predict vote choice. Likelihood ratio tests compare two models that are identical except for one predictor which is present in one model but not the other. If the test yields a significant chi-square value, it indicates that the additional model complexity resulting from adding the additional predictor is warranted.

The different voter groups were incorporated into the analyses by following Galli et al.'s 2021 analysis, with Vote Choice as the between-subjects factor. The groups we compared were Democratic voters and Republican voters -regardless of whether they were decided or undecided - to examine whether the N400 effect aligned with differences in explicit political preference and voting choice.

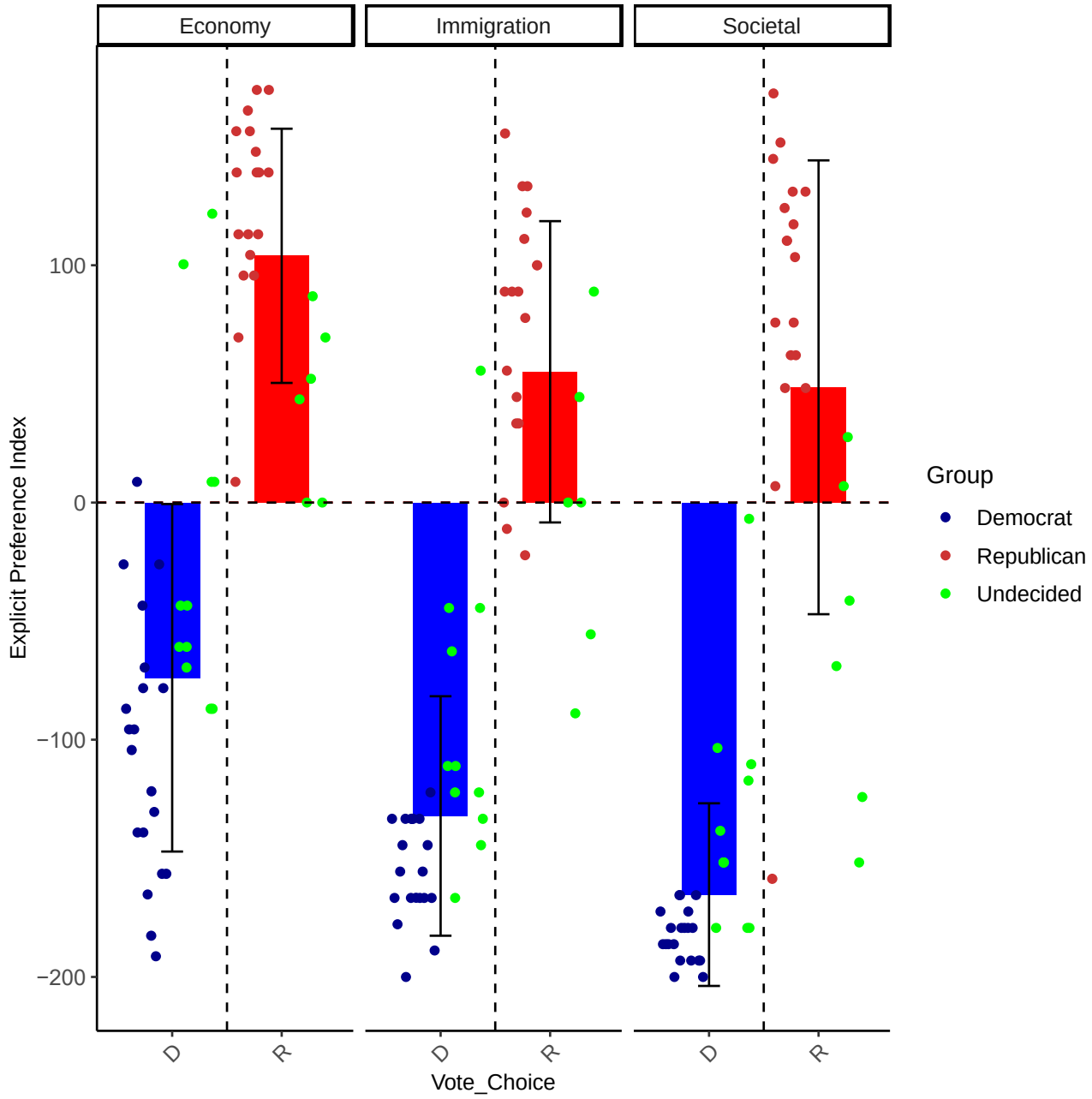
We also compared decided Democrats and decided Republicans. If the N400 effect did reflect differences between decided voters, our plan was to replicate Galli et al.'s 2017 analysis which tested if the N400 effect of undecided voters did not differ from that of the decided voters who voted for the same party as them. For example, to test if the N400 effect of undecided voters who voted Democrat did not differ from the N400 effect of decided Democrats.

Results

Explicit Preference Index (EPI)

Figure 1 shows the mean EPI for the different issue dimensions of economy, immigration and societal statements for participants who voted Democrat or Republican. More positive values indicate greater agreement with Republican views while more negative values indicate greater agreement with Democratic views. Figure 1 shows that participants who voted Republican were more strongly aligned with the Republican party stance on Economic issues (m = 104, range: -61, 163) than participants who voted Democrat with the Democratic party stance (m = -73.9, range: -183, 52). Participants who voted Democrat were more aligned with the Democratic party stance on Immigration (m = -132.1) and Societal statements (m = -165.3) than participants who voted Republican with the Republican party stance on those issues (m = 55.1 and m = 48.6, respectively). Participants who voted Democrat had less variance in their EPIs on immigration and societal issues compared to participants who voted Republican whose explicit preferences on those issues varied considerably. This was less the case with economic issues, for which participants who voted Republican had less variance than participants who voted Democrat. Overall, participants who voted Republican were less aligned with the Republican party stance (m = 67.12, range = -60.87, 163.04) than participants who voted Democrat (m = -127.37, range = -182.61, 52.17).

Figure 1: EPI scores for Democratic (D) and Republican (R) voters across 3 issue dimensions. The same individuals are plotted for each issue.



An ANOVA was conducted with EPI as the dependent variable, Vote Choice (two levels: Democrat, Republican) as the between-subjects factor, and Issue Dimension (three levels: Economy, Immigration, Societal) as the within-subjects factor. The counts in each cell were as

follows: for Vote Choice, 31 participants voted Democrat and 24 Republican; for Issue Dimension, there were three different EPI values per participant, one for Economy statements, one for Immigration and one for Societal issues. There was a significant main effect of Vote Choice ($F_{1,53} = 163.62$, $p < 0.001$, ges = 0.699) and Issue Dimension ($F_{1.95, 103.27} = 51.29$, $p < 0.001$, ges = 0.193). Our post-hoc analyses in table 1 show that the main difference in EPI between issues was between the economy on the one hand and immigration and societal issues on the other, with economy issues receiving less negative scores than the other two issue dimensions. The lack of an interaction with vote choice ($F_{1.95, 103.27} = 3.1$, $p = 0.51$, ges = 0.014) indicates that the vote choice groups differed equivalently on all Issue Dimensions.

Table 1. Means table of EPI scores by ANOVA contrasts

	Economy	Immigration	Societal
Average EPI	3.72	-50.43	-71.98
Democrats	-73.9 (13.15)	-132.1 (9.06)	-165.3 (6.91)
Republicans	104 (10.94)	55.1 (12.96)	48.6 (19.53)

Waveform morphology

Figure 2 shows the grand-average ERPs from the vertex electrode (MiCe) time-locked to the statement-final word. Sensory components in the visual evoked potential (VEP) were followed by a negative-going deflection around 400 ms following stimulus onset with larger amplitude for Republican statements than Democratic statements.

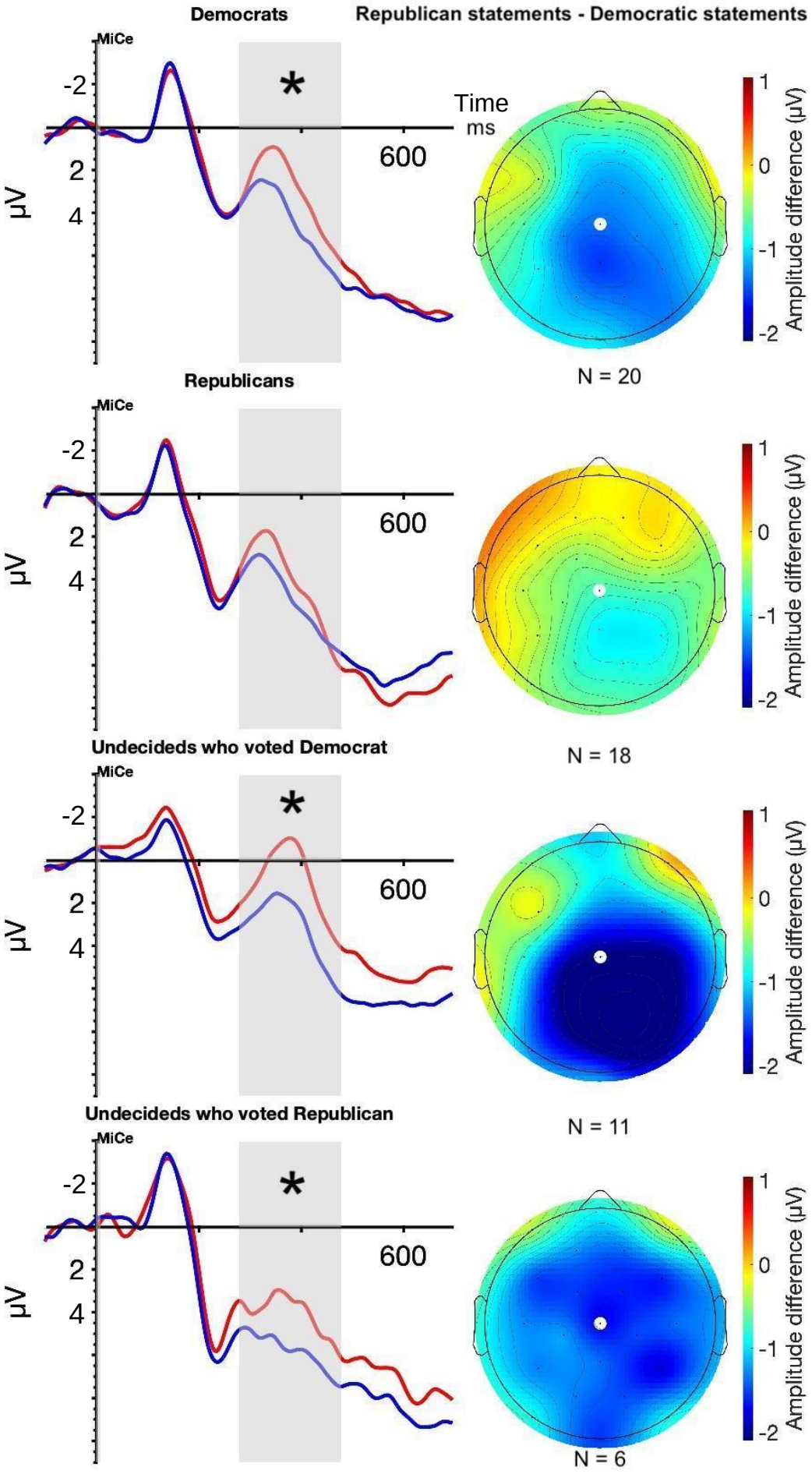

Democrats
Republican statements - Democratic statements
MiCe
-2
2
4
μV
600
*
Time
ms
1
0
-1
-2
Amplitude difference (μV)
N = 20
Republicans
MiCe
-2
2
4
μV
600
1
0
-1
-2
Amplitude difference (μV)
N = 18
Undecideds who voted Democrat
MiCe
-2
2
4
μV
600
*
1
0
-1
-2
Amplitude difference (μV)
N = 11
Undecideds who voted Republican
MiCe
-2
2
4
μV
600
*
1
0
-1
-2
Amplitude difference (μV)
N = 6

Figure 2. N400 in voters who voted Democrat or Republican for governor. The waveforms on the left show the grand averaged waveforms for statements with pro-Democratic (in blue) and pro-Republican (in red) target words. Significant Statement Type differences between Republican statements and Democratic statements are indicated by an asterisk. All waveforms are from the vertex electrode MiCe which is indicated by a white dot on the scalp maps. Grand averaged waveforms for all electrodes can be found in supplementary figures S5, S6, S7, S8. The gray overlay shows the time window used for statistical analyses (278ms – 478 ms). The scalp maps on the right show the scalp distribution of the ERP difference (Republican - Democratic statements) as isovoltage in microvolts.

N400 Mean amplitude

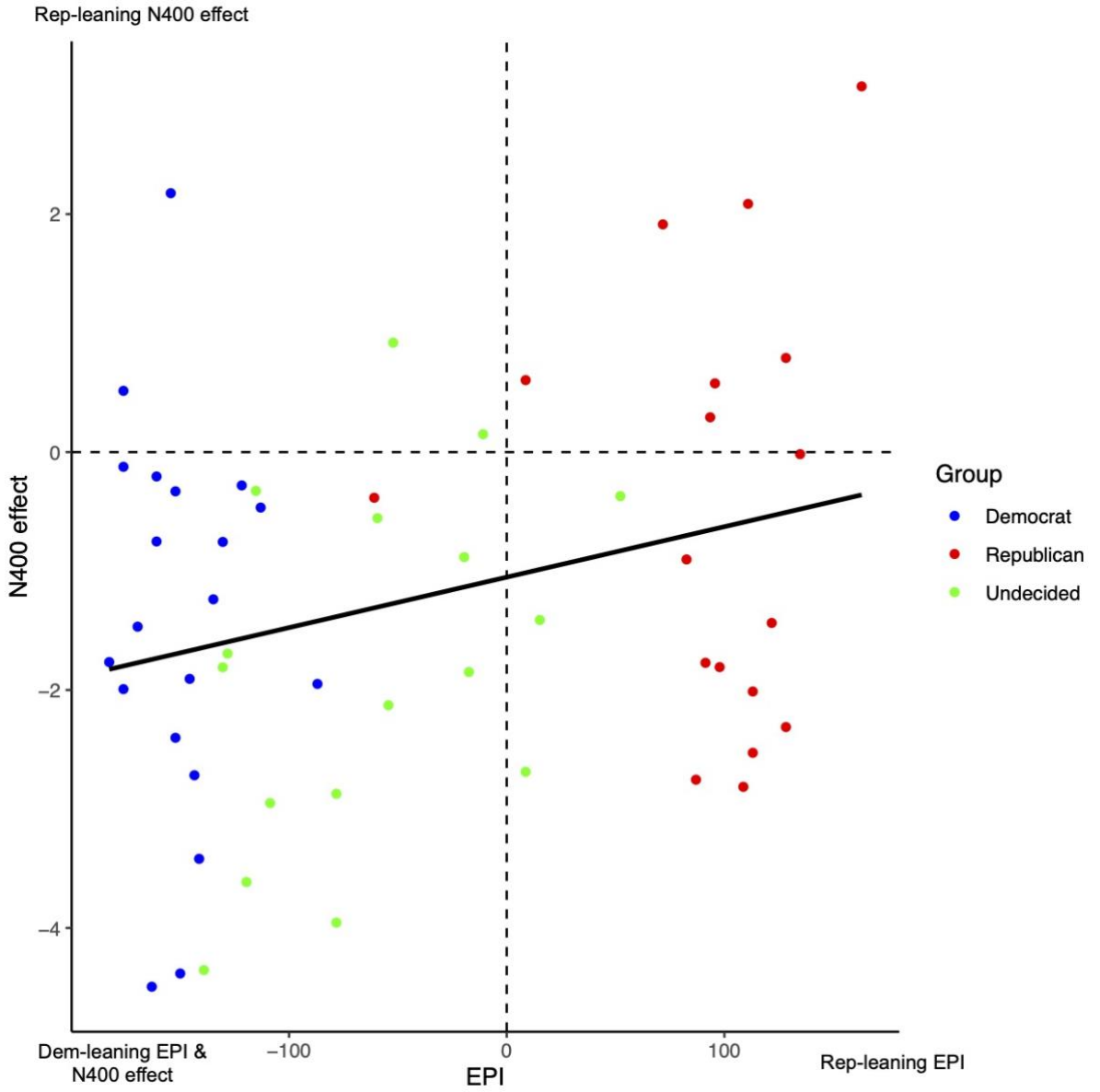
Our first step was to see if we could replicate Galli et al.'s findings by seeing if Democratic and Republican voters presented opposite N400 patterns. Following the literature, the N400 for statements that violate one's political beliefs should be greater than for statements that support them. For Democratic voters, the N400 was therefore expected to be more negative for Republican statements than for Democratic statements. Inversely, for Republican voters, the N400 was expected to be more negative for Democratic statements than for Republican statements. Figure 2 shows the expected pattern for Democratic voters but not Republican voters who do not show the inverted N400 pattern. Undecided voters, whether they ultimately voted Republican or Democrat, show an N400 effect similar to the Democratic voters.

Democratic voters showed larger N400 amplitude to Republican statements than Democratic statements. Decided Republican voters showed no difference in the N400 response to Republican and Democratic statements, as the interaction between Statement Type and

Electrode ($F_{25, 575,} = 1.51$, $p = 0.054$, $\eta_p^2 = 0.001$) is not significant when only looking at Republican voters. On the whole, Republican statements led to larger N400s.

Figure 3 shows the positive and significant relationship between the N400 effect and EPI scores. If participants' explicit political preferences are aligned with their implicit political preferences measured by the N400 effect, dots should either be in the bottom left quadrant for Democrats or in the top right quadrant for Republicans. Although a majority of participants fall in these two quadrants, 12 participants with Republican-leaning EPI scores presented Democratic-leaning N400 effects. These are shown in the bottom-right quadrant. Of these 12 participants, 9 were decided Republicans and 3 were undecided. Similarly, 4 participants with Democratic-leaning EPI scores presented Republican-leaning N400 effects, as shown in the top left quadrant. Of these, 2 were decided Democrats and 2 were undecided.

Figure 3. Individual participants are shown with their respective N400 effect values (in µV) and EPI scores. The black line shows the regression line when regressing the N400 effect on EPI score. The effect of the EPI score on the N400 effect is positive and significant (p = 0.0382, t = 2.125). The breakdown of these data by issue dimension can be found in supplementary figures S10, S11 and S12.



As previously explained, we conducted an omnibus mixed model ANOVA with Vote Choice as a between-subjects factor and within-subject factors of Statement Type, Issue Dimension and Electrode.

The main effect of Vote Choice did not reach significance ($F_{1, 48} = 1.57$, $p = 0.217$, $\eta_p^2 = 0.013$), indicating that the N400 amplitudes to all target words did not differ overall between Republican and Democratic voters. This is expected given that voters read both statement endings. There were significant main effects of Statement Type ($F_{1, 48} = 23.93$, $p < 0.001$, $\eta_p^2 = 0.017$), Issue Dimension ($F_{2.72, 130.65} = 4.03$, $p = 0.011$, $\eta_p^2 = 0.007$), and Electrode ($F_{2.91, 139.86} = 27.11$, $p < 0.001$, $\eta_p^2 = 0.130$). These effects revealed that N400 amplitude was more negative overall for Republican (1.60 μV) than Democratic (2.44 μV) statements and for Immigration statements (1.64 μV) than Economy and Societal statements (respectively 2.18 and 2.44 μV).

These main effects were qualified by three interactions.

The Statement Type by Electrode interaction was significant ($F_{5.21, 250.07} = 9.99$, $p < 0.001$, $\eta_p^2 = 0.003$). Post-hoc analysis revealed that the N400 effect, with larger amplitude for Republican than Democratic statements, was largest over central and parietal electrodes, as is typical for an N400 effect to words.

Issue Dimension by Electrode was significant ($F_{75, 3600} = 1.55$, $p = 0.002$, $\eta_p^2 = 0.001$), but appears to be due to chance as it only concerns one Electrode x Issue Dimension contrast out of 156 contrasts (Immigration statements generated more negative amplitudes than Societal statements at RDCe).

A Statement Type by Issue Dimension interaction ($F_{2.76, 140.98} = 1.84$, $p < 0.001$, $\eta_p^2 = 0.002$) indicated that Democratic and Republican statements differed in N400 amplitude only for Immigration and Societal issues, but not Economic statements, as shown in Table 3. N400 amplitudes for Immigration and Societal statements were more negative-going when they were Republican than Democratic. This happened regardless of Vote Choice given that there was no 3-way interaction with Vote Choice (for a breakdown of N400 responses by Issue Dimension, see supplementary Fig. S1, S2 and S3).

Table 3. Mean amplitude: Statement Type by Issue Dimension

Issue dimension	Economy	Immigration	Societal
Democratic statements	2.22µV	2.2µV	3.02µV
Republican statements	2.16µV	1.08µV	1.86µV

There was no significant interaction between Vote Choice and Statement Type ($F_{1, 48} = 0.96$, $p = 0.331$, $\eta_p^2 < 0.001$) and between Vote Choice and Issue Dimension ($F_{2.72, 130.65} = 0.93$, $p = 0.422$, $\eta_p^2 = 0.002$). This indicates that there was no significant effect of the voting group participants belonged to on the N400 effect. We obtained the same results when limiting our analysis to decided voters. Even in this case, there was no significant interaction between Vote Choice and Statement Type ($F_{5.21, 250.07} = 1.61$, $p = 0.155$, $\eta_p^2 < 0.001$). Because the N400 effect did not reflect differences between decided voters, we did not test whether undecided voters' N400 effects were similar to those of decided Democrats or decided Republicans, as in Galli et al.'s 2017 analysis.

We further explored the interaction between Statement Type and Electrode by means of a distributional analysis, with Statement Type, Anteriority (4 levels: prefrontal, frontal, parietal,

occipital), Laterality (2 levels: lateral, medial) and Hemisphere (2 levels: left, right) as within-subject factors. Electrodes used in the distributional analysis are shown in gray on supplementary figure S9. This analysis found a maximum N400 effect (Republican statements versus Democratic statements) over right hemisphere medio-central electrodes (statement Type by Anteriority, $F_{1.36,\ 73.56} = 5.59$; statement Type by Laterality, $F_{1,\ 54} = 17.21$; statement Type by Hemisphere, $F_{1,54} = 4.04$). The timing and scalp distribution of the ERP waveforms are consistent with a typical N400 effect, which is known to be greatest at central-parietal sites and to peak around 400 ms after stimulus onset (Kutas et al., 2011).

Valence

As a further check, we examined whether differences in valence between sentence-final target words across Statement Type conditions may have impacted N400 amplitudes. Some of our sentence-final target words vary in valence. For example, the word "patriot" and "thug" have different emotional valence. Unless controlled for across the two conditions, differences in valence could have potentially affected N400 differences between groups and represented a potential confound that could have led to no differences in the N400 effect across groups.

To determine whether differences in valence affected N400 differences between groups, we checked whether a difference in valence existed between stimuli across the two conditions. In other words, whether pro-Democratic and pro-Republican statements presented a difference in valence. To do this, we consulted a database with valence scores for nearly 14,000 English words[38]. The database provided valence scores for 163 out of 184 stimuli. 10 stimuli were proper names like "Biden" and "Abbott" and do not have valence ratings in published norms. 11 stimuli were not present in the database and are reported in the supplementary information.

The database gives the dictionary, singular form for nouns and the infinitive form for verbs. It does not contain adverbs so we used the valence of the corresponding adjective instead (e.g. using the valence of "appropriate" for the stimulus "appropriately"). We ran an ANOVA with Statement Type as between-subjects factor and Valence score as dependent variable. There was no significant main effect of Statement Type on Valence and hence no overall difference in Valence between pro-Democratic and pro-Republican statements ($F1, 160 = 3.09$, $p = 0.081$, $\eta p2 < 0.019$). As there was no difference in Valence across conditions, Valence cannot explain the absence of N400 differences between groups. We include the valence scores of our stimuli in the Supplementary Information.

Logistic regressions

We turn to the question of whether the N400 effect is a significant predictor of voting behavior and how it compares to other variables. We inserted each of the variables described in the Predictors section as the single predictor of a logistic regression predicting Vote Choice. We set the reference category of Vote Choice to "Republican". The coefficients in Table 4 show the changes in log odds of voting Republican. For the N400 effect variables, we used the absolute average voltage of the subset of electrodes where the N400 effect was greatest. These electrodes were determined on the basis of a visual inspection of the scalp maps and included MIPa, MiCe, LMCe, RMCe, LMOc, RMOc, LDPa and RDPa.

Table 4. Logistic models. Table 4 shows the coefficients and standard errors (in parentheses) of the single-predictor logistic models, with their different levels of significance.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Child-rearing authoritarianism	-0.576 **							
	(0.197)							
VSAS		-0.347 ***						
		(0.101)						
Economy perception			1.182 *					
			(0.497)					
Biden job approval				3.330 **				
				(1.083)				
Top issue: Societal issues					2.680 ***			
					(0.755)			
Explicit Preference Index						-0.041 **		
						(0.012)		
N400 effect							-0.313	
							(0.176)	
N400 effect - Economy								0.05
								(0.09)
N	55	55	55	55	52	55	55	50
AIC	68.209	61.331	72.723	60.806	58.399	22.446	75.894	73.967

*** p < 0.001; ** p < 0.01; * p < 0.05.

The overall N400 effect (p = 0.07, z = -1.782), which included all statements, did not predict voting behavior at the 0.05 level of significance, nor did the N400 effects for Immigration (p >

0.1, z = 0.94), Societal ($p > 0.1$, $z = 0.56$) or Economy ($p = 0.067$, $z = 1.62$) Statements. This is consistent with the fact that we did not find the N400 patterns we were expecting to replicate from Galli et al.'s studies. Because the direction of the N400 effect did not co-vary with voting differences, the N400 effect was not a significant standalone predictor of Vote Choice.

The Explicit Preference Index ($p < 0.01$, $z = -3.29$), had a high level of significance in predicting Vote Choice, as did its components, the EPIs for Economy ($p < 0.001$, $z = -3.94$), Immigration ($p < 0.001$, $z = -3.73$) and Societal ($p < 0.001$, $z = -3.61$) issues. Voting Intention was also a significant predictor of actual Vote Choice ($p < 0.001$, $z = -3.77$).

Our two variables measuring authoritarianism, child-rearing values ($p < 0.01$, $z = -2.92$) and VSAS ($p < 0.001$, $z = -3.42$), were both predictive of voting behavior. Economy perception ($p < 0.05$, $z = 2.38$) also predicted voting behavior, with voters who thought the state of the economy was 'Good' or 'Only Fair' more likely to vote Democrat than Republican. Positive approval ratings of the president – who at the time of the election was Joe Biden, a Democrat – significantly increased the likelihood of voting Democrat ($p < 0.01$, $z = 3.07$). Gender was a significant predictor, with women more likely than men to vote Democrat ($p < 0.05$, $z = 2.31$), although this gender difference is likely to be due to sampling given the relatively small sample size per group and the higher proportion of women among decided Democrats compared to the other groups.

The variable 'most important problem facing the country' ($p < 0.001$, $z = 3.55$) was predictive of voting behavior: voters for whom the top issue facing the country was societal issues (abortion, race relations, gun rights) were more likely to vote Democrat than voters for whom the top issue was the economy.

Political knowledge ($p > 0.05$, $z = -0.13$) and race and ethnicity ($p > 0.05$, $z = \{ -0.989 : 1.399 \}$) did not predict voting behavior. The latter could be due to the high number of levels (9) in the race/ethnicity factor, with unequal numbers across the different levels.

Likelihood ratio tests

Following Galli et al.'s approach, we examined whether adding the N400 effect to the EPI improved model fit. We ran likelihood ratio tests comparing a model with only the EPI to a model with both the EPI and the different types of N400 effect (overall, Economy, Immigration, Societal). The test showed that adding the N400 effect for Economy issues to the EPI significantly reduces deviance from 17.39 to 12.78. The fact that the test is significant indicates that the additional model complexity resulting from adding the N400 effect for Economy statements as a predictor is warranted. Adding the overall N400 effect or the N400 effect for Immigration statements or the N400 effect for Societal statements to the EPI did not significantly reduce deviance compared to the model with only the EPI.

Table 5 - Analyses of Deviance

Model name	χ^2	**df**	**p-value**
EPI model + N400 Economy	4.62	1	0.03
EPI model + overall N400	0.04	1	0.85
EPI model + N400 Societal	0.1	1	0.75
EPI model + N400 Immigration	2.33	1	0.13

Discussion

The goal of this study was twofold: to see if the N400 effect reflected differences in political alignment and if this and another implicit measure of political preference, namely authoritarianism as measured by the child-rearing values scale, could predict vote choice above and beyond explicit voter preferences. The research hypotheses were based on previous work with European voters (Galli et al., 2017; Galli et al., 2021) and were tested in young adult voters in the US. Under the assumption that the N400 effect would reflect vote choice and explicit political preferences in decided voters, we predicted that implicit measures of political preference would better predict undecided voters' vote choice than explicit measures of political preference.

Our data show that the explicit measures of political preference performed well in predicting vote choice. The EPI, the president's job approval, the VSAS and "the most important issue" predictor were all significantly predictive of vote choice. In addition, our second implicit measure of political preference, authoritarianism as measured by the child-rearing scale, was predictive of vote choice, with higher scores indicating a greater probability of voting Republican. As mentioned in the introduction, authoritarianism has been shown to predict electoral swings in different countries. Stenner and Haidt (2018) showed that individuals with high authoritarianism scores were considerably more likely to vote for far-right parties in conditions of high normative threat. Our implicit measure of authoritarianism (the child-rearing scale) did not predict vote choice above and beyond our explicit measure of authoritarianism (the VSAS) or above and beyond the other explicit measures of political preference (e.g. EPI, top issue facing the country) as these were also highly significant predictors of vote choice and had similarly substantial effects. However, it offers a valuable insight. Although our sample

was not polarised on certain issue dimensions (Democrats on the Economy, Republicans on Immigration and Societal issues), Republican and Democratic voters were split along the dividing line of the social attitudes measured by authoritarianism, which are conformity to in-group norms and deference to political leaders. Future research could ascertain whether this factor was the key influence in shaping the vote choice of undecided voters who voted to the right, of which we had too small a sample (N = 6) to draw inferences from.

However, our results for the N400 effect differed from what was previously observed in Italian and British voters in Galli et al.'s findings. Galli et al. found that the N400 effect aligned with vote choice in decided voters, with Remain voters presenting larger negativities for Leave compared to Remain statements and Leave voters displaying the opposite, with larger negativities for Remain compared to Leave statements. In our study, we expected Democratic voters to display larger N400 amplitude for pro-Republican compared to pro-Democratic statements, and for Republican voters to display the reverse pattern, with larger negativities for pro-Democratic compared to pro-Republican statements. We did find this with Democratic voters but not with Republican voters. There was no significant group difference in N400 patterns, with pro-Republican statements eliciting larger N400 amplitude than pro-Democratic statements in both Republican and Democratic voters. Follow-up ANOVAs suggested that decided Republicans showed no statistical difference between statement types. The undecided voters as a group displayed a similar pattern to (not significantly different from) decided Democratic voters, with larger responses to pro-Republican than pro-Democratic endings. However, not all undecided voters chose to vote Democratic (11 voted Democrat and 6 Republican).

Critically, these findings do not compromise the use of the N400 to detect preferences in undecided voters because preferences and actual behavior are distinct phenomena. The N400 effect failed to predict the behavior, which is voting. However, the evidence does not suggest that it failed to predict preferences, specifically implicit preferences. Rather, it would seem that it detected implicit preferences and those preferences happened to be different from explicit preferences among decided Republicans.

Other research has also shown dissociations between behavioural measures and brain activity. McLaughlin et al. (2004) for example suggested that behavioral assessments of second language learning underestimated the amount learned by participants. They argued that "ERPs might more accurately reflect implicit learning and continuous change in knowledge than do explicit, categorical judgments". This did not entail that their implicit (neural) or explicit (behavioral) measures were invalid. Cerda et al. (2019) also observed a dissociation between behavioral measures and ERPs. Although the object of research in these studies was language learning and bilingual cognition, the same is likely to apply to political judgments and attitudes. Arguably, ERPs more accurately reflected implicit preferences, even if explicit preferences ultimately weighed more than implicit preferences in shaping voting choices. Furthermore, if behavioural and neural measures covaried perfectly and accounted for exactly the same variance, there would be no purpose in recording implicit measures like ERPs.

It is important to note that even in the Galli et al studies, the N400 effect was not always predictive of voter behavior. Galli et al. (2021) found that the N400 effect for economic issues was predictive of Italian voters' choices, while the N400 effects for cultural and anti-establishment issues were not. Our logistic models show that neither the overall N400 effect nor the issue-specific N400 effects were predictive of vote choice when inserted as single

predictors in a logistic regression. However, inclusion of the N400 effect for Economy in more complex models did improve the predictive ability of measures of explicit preference, like the EPI. This suggests that it might be explaining a portion of variance corresponding to implicit preferences which the EPI does not account for.

This finding is especially notable given that participants were less polarised on the Economy than on Immigration or Societal issues (see supplementary figures S10, S11 and S12), yet the N400 effects for Immigration and Societal issues were not predictive and did not improve the predictive ability of measures of explicit preference. One speculative explanation for this could be that the EPI scores for Immigration and Societal issues already accounted well for the variance relative to those issue dimensions, which meant that the N400 effect could not add much to those EPI variables' predictive ability. For the Economy, on the other hand, the N400 effect may have added more to the EPI's predictive ability because participants' explicit preferences were less polarised on the Economy and therefore the EPI may have accounted for less variance on the Economy than it did on Immigration and Societal issues.

The fact that Republican voters did not present larger N400 amplitude for pro-Democratic compared to pro-Republican statements could have different explanations. This finding may be surprising given that the US is characterized by a more polarized political context (Boxell et al., 2020) than the European countries the two Galli et al. studies were set in and where N400 responses were inverted for participants from opposing political sides. Although notably, data from the EPI scores suggest that our sample of decided Republicans were less polarized than our sample of decided Democrats. The lack of difference in N400 responses to pro-Democratic and pro-Republican statements among decided Republicans is consistent with the fact that this sample of Republican voters was less polarized as a group. In other words, the N400 effect, as

an implicit measure of political preferences, reflects that this sample on average was less consistently polarized to the statements than the decided Democrats in our sample.

The context in which the 2022 midterm elections took place is another possible explanation. The elections took place a few months after the Supreme Court of the United States overturned Roe versus Wade, which had enshrined women's right to abortion since 1973. Although the congressional Republican party had been actively pursuing this outcome for several years, a sizable minority of Republican voters, approximately 30% at that time (Pew, 2022), opposed it. The N400 effects we observed among Republican participants might have been partially due to the fact that some of them had conflicting or at the least mixed explicit preferences, although they voted for the Republican party.

Among our participants, most Republican voters' brain responses suggested agreement with Democratic statements, according to the N400 effect. Yet, membership of a political group and explicit preferences seem to have been the key factors behind vote choice rather than the implicit preferences measured by the N400 effect. Recent accounts (Baron, 2022) have found that group membership and conformity with one's in-group have been major determinants of electoral behavior in recent years. The fact that the N400 effect was not predictive of vote choice could suggest that conformity with in-group values was more important than individual responses to policy statements (as measured by the N400 effect) when determining one's vote.

The EPI scores reported in Figure 1 support this interpretation to a certain extent. Republican voters had greater variance on Immigration (sd = 63.49) and Societal issues (sd = 95.66) than Democrats (sd = 50.47 for Immigration and sd = 38.49 for Societal issues), whose EPI scores showed considerable homogeneity on those issues. Some Republican voters' EPI scores on

Immigration and Societal issues were in fact aligned with the Democratic party stance, as indicated by the data points under the Republican bars scoring negatively (which indicates alignment with the Democratic party stance). This was not the case with Economy issues where Republican voters (sd = 53.57) showed greater homogeneity in their EPI scores than Democratic voters, whose EPI scores were more spread out (sd = 73.23) and, for some participants, were aligned with the Republican party stance on Economic issues. The fact that group membership -often referred to as partisan affiliation- had a greater influence in shaping vote choice than the individual implicit preferences measured by the N400 effect could be a reflection of the importance of group membership for American voters.

It is also possible for the context in which data acquisition occurs to influence participants' neural responses. Previous studies have shown that participant expectations, which develop during an experiment as a result of the experimental manipulation, can influence N400 responses. Several studies have shown that the N400 is reflective of contextual expectations (Federmeier, 2022; Kutas et al., 2011). The ERP patterns observed among Republican voters might have been influenced by their expectations given the experimental context (e.g. if they assumed that pro-Republican statements would be less common in a university environment) rather than solely driven by their own personal beliefs. However, this is unlikely given that the sentences presented were equally likely to end with a word that was pro-Republican or pro-Democrat. Participants would have quickly realized that the statements were not biased toward a more liberal perspective.

Moreover, there is evidence for participant acquiescence bias in different research contexts, although not using ERPs specifically (Baron-Eppel, 2010; Podsakoff, 2003). Participants have been known in certain cases to bias their own answers to try to align with what they perceived

the experimenter to want. If participants in our study perceived the university (i.e. the context in which the research occurred) as being "on their side", belief-congruent statements could be matching participants' predictions, whereas if they believe the university is against their views, belief-incongruent statements may be matching their predictions instead. However, we do not know if such acquiescence bias took place and can only speculate as to the direction in which it would have occurred. Critically, the N400 response is pre-conscious (Luck et al., 1996). Perceived alignment or divergence with the university would be at least in part a conscious reasoning which cannot deliberately alter the N400 response.

Stimulus valence can also modulate the N400, with larger N400 amplitude for words that are negatively valenced than for positively valenced words (De Pascalis, 2009; Martín-Loeches, 2012; Ding et al., 2015). In our data, pro-Democratic stimuli never elicited larger N400 amplitude in any of the groups (Democrat, Republican or undecided voters). One might argue that there could have been an overall difference in valence between statement types, leading the pro-Republican stimuli to be perceived as more negatively overall by all participants. However, we can rule this out as a possible explanation given that there was no overall difference in valence between pro-Democratic and pro-Republican statements.

In conclusion, we found that the N400 effect correlated with expressed policy preferences among Democratic voters but did not significantly co-vary with or independently predict voting differences between Democratic and Republican voters. The N400 effect showed a marked preference for pro-Democratic statements in Democratic voters and suggested ambivalence between pro-Democratic and pro-Republican statements in decided Republican voters. This finding was, to a certain extent, corroborated by the EPI, which showed Republican voters being less aligned with their party than Democratic voters were with theirs. Although the N400

effect did not behave in the way we predicted, it does appear consistent with the subtle differences in political preferences expressed explicitly through our EPI score. Contrary to our predictions, the N400 effect did not correlate with vote choice. Implicit measures like the child rearing authoritarianism scale currently show a clearer ability to predict voting behavior compared to the N400 effect. Given previous demonstrations (Galli et al., 2017, Galli et al., 2021) in which the N400 effect was predictive, it is currently unclear why the N400 neural response might enable significant predictions in some contexts but not others. We originally anticipated that neural signals like the N400 effect might be even more predictive in highly polarized contexts like the US. Perhaps partisan identity-based voting means that this particular measure, which is dependent on semantic processing by each individual, is actually less able to predict voting decisions than group-wide preferences.

Author contribution statement

Emmanuel Mahieux designed research, carried out data collection, data processing, statistical analyses, generated figures, wrote different versions of the manuscript and coordinated co-authors. Nicole Wicha designed research, oversaw logistic preparations of data collection, provided support during data collection, interpretation of results, provided feedback and edited successive versions of the manuscript. Lee De Wit designed research, provided feedback and edited successive versions of the manuscript. Leun Otten designed research, provided guidance on data processing and statistical analysis and edited the manuscript. Joe Devlin designed research, set up the collaborative effort and edited the manuscript.

General Discussion

This thesis investigated whether swing voters presented distinct traits by investigating the psychological, cognitive and neural correlates of swing voting. Our findings and contributions to the literature are multifaceted. Swing voters do appear to have distinct psychological traits, as our first study found. Swing voters had higher openness to new experience, a finding which is intuitive as individuals more open to experience are more able than others to envisage alternatives in the way the country can be run and in who should be leading it. This makes them more open to the notion that a new or different candidate or party should be in charge, something which partisan voters are less able to envisage. In this dimension, our results are consistent with those of Bakker et al. (2016). Being more open-minded makes voters more likely to switch party overall, regardless of the direction they are switching to. In our first study, we also found that age was predictive of switching, with younger voters more likely to switch and older voters less likely to do so. Our second study confirmed this finding.

One difficulty in our results is finding correlates and characteristics of swing voting that apply across all contexts rather than in specific, context-dependent switching directions. Electoral dynamics tend to be very specific to every election and to the personalities of the candidates running in it. In fact, some of the attributes we found for swing voters overall were the opposite of those of swing voters switching in specific directions. When looking at all swing voters in our first study, they had higher openness and higher trust in MPs. When looking at swing voters who switched from the mainstream parties to UKIP, they had lower trust in MPs and higher authoritarianism scores. Thus, swing voters can present distinct psychological characteristics compared to non-swing voters. However, those distinct characteristics can vary across specific groups of swing voters and even be contradictory.

Swing voters overall -looking at all switching directions- had higher openness to experience but switchers to the far-right (to UKIP) tended to have more authoritarian personalities. Authoritarianism implies an intolerance of difference, making it antithetic to openness to experience, which requires being open to different experiences.

Moreover, the fact that openness to experience was associated with a higher probability of vote switching hides the complexity of openness as a trait. We found that openness was predictive of swing voting, but this could be due to a specific facet of openness, a subset of facets or other cognitive or emotional characteristic of people who are more open to experience.

In fact, openness in itself is the most complex of the Big 5 personality traits, which poses the question of which of its constituent parts underlies the association with swing voting. When personality researchers conducted the factor analyses that eventually led to the formulation of the 5-factor model, the last, fifth factor (Vth factor) was not labelled as "Openness" at first but as "Culture" (Norman, 1963), "Intellect" (Peabody et al., 1989) and "Imagination" (Saucier, 1994), underscoring how broad and open to different interpretations this personality trait is. John and Srivastava (1999) noted that the personality items that loaded substantially onto the Vth factor included characteristics such as "artistic", "curious", "original", "wide interests", "intelligent", "insightful" and "sophisticated". In their analyses and in the NEO personality questionnaire they developed, Costa and McCrae (1992) outlined six facets of openness: Ideas (curious), Fantasy (imaginative), Aesthetics (artistic), Actions (wide interests), Feelings (excitable) and Values (unconventional). The question is which of these facets underlies the association with swing voting.

The Big 5 measure that we used is the ten-item personality inventory (TIPI, Gosling et al., 2003), which uses only two items to measure openness to experience. The TIPI asks respondents to what extent they see themselves as "open to new experiences, complex" and as "conventional, uncreative".

The relationship of openness with complexity and convention offers an explanation on the link with swing voting. Costa and McCrae (1992) found that non-conformity loaded positively onto factor V while conventionality loaded negatively onto it. In a comment on an individual who scored very high in openness, McCrae (1994) elaborated that "very high scorers […] seek out novelty and variety, and have a marked preference for complexity. […] Their attraction to new ideas and alternative values systems may make them especially tolerant of others, and may lead them to adopt unconventional attitudes" (pp. 49-50). Switching the party that one votes for can be considered an unconventional attitude in that the majority of voters, in most democracies, do not switch parties. It can constitute an unconventional attitude particularly if a voter switches parties in a way that diverges from how their peers vote. Being open to adopting unconventional attitudes is a facet of openness that may thus contribute to the trait's association with swing voting.

Having a "marked preference for complexity" may also explain part of the association between openness and swing voting. Making an informed voting decision requires, theoretically, the processing of complex information, i.e. with individuals engaging with complex political debates and policy issues. When making their decisions on who to vote for, many voters rely on heuristics such as party cues, which can be done at the detriment of engaging with the full breadth and complexity of the issues at stake in an election. As open-minded individuals present a "marked preference for complexity", they might be able to

consider multiple voting options because they have thought about the different political debates and policy issues discussed ahead of the election. While some voters rely on heuristics to address or simplify complex political debates and questions, it would be interesting to explore whether open-minded voters embrace this complexity, and whether this in turn makes them more likely to swing.

However, the TIPI only measures four of all the facets attributed to the trait of openness. To determine which other facets may underlie the association between openness and swing voting, we would need a more extensive battery of items measuring the different facets of openness. This is made even more necessary by the fact that Openness in the TIPI is the personality trait with the lowest convergent correlation with its equivalent in a more extensive battery of items like the Big Five Inventory (BFI). TIPI measures of Conscientiousness, Extraversion, Agreeableness and Emotional stability had convergent correlations of 0.65, 0.80, 0.58 and 0.69 with their respective BFI equivalents against 0.48 for Openness. This relatively low convergent correlation implies that we don't know if it is only the facets of openness that we had data on that predict swing voting or if other facets might as well.

Of the six facets of Openness documented in the BFI, we could speculate that being curious or excitable (Ideas and Feelings facets) may also contribute to the link with swing voting. Curious individuals might be curious to see what policies will come out of a new government (which would require them to switch their vote to come into power). Excitable individuals might become enthusiastically committed to a new political cause or leader they had not endorsed before and change their voting behaviour accordingly. It is harder to see how artistic types and individuals with wider interests would be more predisposed to being swing

voters but these facets (Aesthetics and Actions) could also be explored with a more extensive battery of items.

The effect size of openness on vote switching was small, with the odds ratio indicating that a one-unit increase in openness made voters 1.02 times more likely to switch parties. This suggested that it only influenced swing voting marginally. However, if we could identify precisely which facet of openness underpins the association with swing voting, the effect size would likely be greater. The reason for this is that Big 5 openness is a broad construct comprising multiple facets. It is unlikely that all of its facets contribute to swing voting, implying that some of them may be adding noise to the relation between openness and swing voting. If we could identify the facet(s) that underpins this relation, we would expect the effect size to be greater.

In our second study, we tested whether swing voters presented a different cognitive style compared to other voters. Our findings were unexpected as there was no difference in styles of thinking between swing voters and other voters. Both groups of voters integrated confirmatory and disconfirmatory information at similar levels and had similar metacognitive ability. We only tested specific cognitive processes and different tests may yet reveal distinct styles of thinking for swing voters. Nevertheless, our findings suggested that the difference between swing voters and other voters did not pertain so much to their style of thinking and processing of information as to differences in values and personality. The dividing line between swing voters and other voters was authoritarianism, with higher scores predicting sticking with Trump and lower scores switching to Biden. These findings provide some degree of evidence against the "rigidity of the right" hypothesis by showing that the voters who kept voting for the right-wing candidate in both presidential elections presented no

(meta-) cognitive failure in the way they processed information and updated their own beliefs in an objective task.

Our third study aimed to establish whether there were neural correlates to swing voting. We based our study on earlier research (Galli et al., 2017; Galli et al., 2021) that found that undecided voters, who claim not to have definitive voting intentions or any at all, have implicit political preferences that make them lean towards one voting option and can be identified with the N400 ERP. Based on this literature, we used the N400 as a somatic marker of disagreement with political statements. In other words, as a marker of instant, pre-conscious judgements. The authors of the previous N400 studies upon which we based ours had found that the N400 responses of undecided voters who voted Remain at the 2016 EU referendum were the same as those of decided voters who voted Remain. In our study, we found no significant group difference between decided voters who voted for the opposite parties. Decided Democrats had larger N400 effects to pro-Republican statements compared to pro-Democratic statements, in line with our hypothesis. However, there was no difference in decided Republicans' N400 responses to either statement type. If we compare the N400 responses of undecided voters who voted Democrat to those of decided Democrats, they present no significant difference. This would be in line with the literature (Galli et al., 2017) in showing that undecided voters had implicit preferences captured by the N400 marker and that these preferences were consistent with the way they ended up voting. However, even the undecided voters who voted Republican presented no significant difference in their N400 responses when compared to decided Democrats. Swing voters' voting behaviour could not be entirely accounted for by the neural correlates of their implicit political preferences as these accounted only for one group of undecided voters: those who ended up voting Democrat but not those who voted Republican.

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This thesis constitutes the first systematic attempt to map swing voters' distinctive traits across different layers, psychological, cognitive and neural. Although some of our findings, particularly in our second study, are null results, these are equally important to the understanding of swing voters and to inform and guide future research. We now have evidence that swing voters do not present distinct cognitive styles compared to other voters in terms of belief updating, confirmation bias and metacognitive ability. In light of these findings, future research will be able to focus on cognitive processes where swing voters are more likely to present distinct cognitive styles.

Authoritarianism has been a leitmotiv of specific switching directions throughout our research. Although authoritarianism scores do not predict switching in all directions, they have predicted switching from the mainstream British parties to UKIP; voting for Trump twice instead of switching to Biden; and voting for the Republican candidate for governor of Texas rather than for the Democratic candidate. Authoritarianism scores have thus predicted swings and voting choices for far-right and populistic right-wing candidates and parties in recent UK and US elections. This includes voting decisions to switch to these parties, as in UKIP's case, and decisions not to switch, as in the case of sticking with Trump in 2020.

Authoritarianism, at its core, measures a person's predisposition to adhere strictly to group norms and submit to group leaders even at the expense of individual autonomy (Engelhardt et al., 2018) and is associated with an intolerance of difference. It was measured in different ways across our studies. In our first study, we used a measure of authoritarianism similar to

Bizumic's (2018) very short authoritarianism scale (VSAS). For the second, we used Stenner and Engelhardt's (2018) child-rearing values questionnaire. For the third, we used the child-rearing values questionnaire as well as the VSAS. The child-rearing scale measures authoritarianism without using explicitly political items. It asks which "qualities" - fundamentally these are personality traits- it is more important for a child to have. Overall, the construct of authoritarianism measures individuals' relationship to political authorities and other social groups, as well as their preferences in the balance between adherence to social norms and individual freedoms.

Authoritarianism is an attempt to map the personality attributes that make even ordinary people susceptible to embrace parties and politicians that have highly aggressive rhetoric, advocate the curtailing of individual freedoms and the targeting of social outgroups. This is a challenging task because the individuals of interest in this vein of research are ordinary people rather than extremists. Trying to predict whether acquaintances such as a local shop owner or primary school teacher could swing to the far-right would prove challenging to most. However, the majority of far-right voters are ordinary people like the above-cited examples rather than committed party members and ideologues. Authoritarianism as a construct serves the purpose of detecting the subtle cues that can indicate someone's potential to swing to the far-right. Metaphorically, it could be described as a sonar system: authoritarianism constructs detect small, almost imperceptible signals of latent beliefs below the surface, even if all seems calm above. The RWA scale and the VSAS do this in a way that is not as sensitive as they mimic the rhetoric of far-right politicians and ask respondents the extent to which they agree or disagree with it. This makes the VSAS a good tool to identify patently held authoritarian beliefs, as it did in the first and third studies. However, it is a less reliable measure of latent authoritarian predisposition than the child-rearing values

questionnaire, which taps into latent authoritarian tendencies. The latter is more insightful because some people who voted for moderate parties and hold moderate beliefs can potentially swing to the far right if they have an authoritarian predisposition and perceive a normative threat as Stenner and Haidt (2018) have argued.

Normative threat can be defined as "a threat towards cultural values, social norms or to society in general" leading those high in authoritarianism to "feel an increased need for social conformity, […] long for strong leaders and […] punish those who break social norms" (Buchanan, 2023, p. 138). Stenner and Haidt (2018) showed that a personality's authoritarian predisposition is activated in situations of normative threat. Under normative threat, individuals with authoritarian personalities become highly likely to vote for far-right parties and candidates, which they would have been substantially less likely to do in the absence of normative threat. It is plausible that the electoral contexts we studied presented some form of normative threat which would have been perceived by our UKIP switchers and Trump stickers who scored high in authoritarianism. This would be consistent with the climate of mounting polarisation that characterised the run-up to the Brexit referendum, the 2020 US election and the post-Trump presidency mid-terms. This would suggest that conformity to group norms played a considerable role in leading many British voters to switch to UKIP and many Republican voters to stick with Trump. Authoritarianism was originally developed to explain the behaviours underlying the swing of many European voters to the far-right in the late 1920s and 1930s. It is striking that the same concept, although its measurement has considerably evolved since the first F-scale by Adorno et al. (1950), should also be a valid tool for explaining individual decisions to swing or not to swing in the last ten years in mature democracies.

We would expect our results relative to cognitive and neural correlates of swing voting to generalize to other countries because there are no apparent reasons why the relative number of swing voters in the electorate would affect the magnitude, direction or significance of these results. We would expect our results relative to authoritarianism to replicate only in democracies where normative threat is as salient as in the US and UK. The reason for this is that authoritarian personalities -and their propensity to swing to the far-right- are activated by salient normative threat. At the time of writing, far-right parties increased their share of the vote across the entire European Union by approximately 2.7% at the 2024 European parliamentary elections, which suggests that normative threat may well be salient in many of these EU member states and that authoritarianism should plausibly account for switching behaviour. This was particularly the case in France, the second-largest state of the European Union, where the far-right Rassemblement National was the most-voted party for the second consecutive European election with an electoral swing of 8 percentage points from 23.34% to 31.37%. In the interwar period, the threat of communists taking power as well as the pervasive sense of economic insecurity and poor economic outlook caused by the great depression constituted the normative threat which would have activated authoritarian personalities and made them swing to the far-right. Today, if the theory is correct, other normative threats must be present to activate authoritarian personalities. According to a cross-EU survey, the issues that were most salient in the run-up to the European elections were the cost of living, immigration and the Russia-Ukraine war (Kapa Research, 2024). It is plausible that high levels of immigration in the past decade may be driving, for many voters, the sense of normative threat. This is made even more plausible by the fact that between 60% and 90% of voters polled in the different countries saw immigration as a "threat to public order". The spectre of war that Russia's invasion of Ukraine has cast over Europe is also likely to constitute such a threat, particularly in Eastern European countries that share a

border with Russia or Ukraine. Thus, although our findings on swing voters are drawn from atypical electoral scenarios, we would expect them to generalize to other contexts, particularly to other European countries.

As we discussed earlier, explaining and predicting swing voting behaviour overall, for example in all switching directions, can be difficult because the distinct traits of swing voters can vary dramatically across different subgroups. The fact that swing voting is a multifaceted phenomenon makes finding predictors that account for swing voting at the aggregate level challenging. In fact, the present research has not found conclusive evidence of a distinct psychological category of "swing voter". The only psychological factor we uncovered that unites all swing voters in all switching directions was openness to experience. Swing voters did not form a distinct category in terms of cognitive style and confirmation bias, nor did they present distinct neural responses in semantic processing compared to other voters. The factors that were predictive of swing voting were specific to the electoral and historical contexts the data were collected from. Authoritarianism was predictive of switching to the far-right and populist right in situations of normative threat, something which has been occurring across many Western democracies in the past decade. The fact that gender was predictive of switching to Biden in our second study is specific to the context of the US 2016 and 2020 presidential elections. The Democratic candidate was female in 2016 and male in 2020, which suggests that gender bias led some voters away from the Democratic party in 2016 but saw them return in 2020.

Thus, our findings suggest the prevalence of context-specific psychological factors underpinning swing voting, rather than of a distinct psychological category of swing voting. This contrasts with certain media and political party narratives on voting behaviour before

elections. These narratives often purport the existence of certain "types" of voters, which are usually composed of a mixture of demographic and political factors. For example, in the UK in the year preceding the 2024 general election, newspapers were reporting that the swing voters that the Labour party had to win over in order to win the next election were "Stevenage woman" and "Workington man". These types were initially proposed by the Labour party's think-tank Labour Together following a collaboration with Yougov (Simons et al., 2023). "Stevenage woman", for example, was described as a suburban resident, "young, hard-working, but struggling to get by, she feels that national politics makes little difference to her life and her town. Her attitudes aren't dogmatic, leaning a little towards social conservatism and a little towards a more interventionist state" (p. 6). This categorisation of swing voters is reminiscent of the creative -and in most cases arbitrary- categories that US political consultants and journalists invented and that we discussed in the Introduction (NASCAR dads, soccer mums, etc.). This categorisation of the electorate into "types" is arguably influenced by market research companies that try to persuade political parties that there are "types" of voters that are more likely to respond favourably to their political messaging. The Labour Together report was authored jointly with Yougov. The "moral clans" framework (Turner et al., 2018; Surridge, 2018) which also informs segmentations of the electorate was developed in partnership with BMG Research, to cite a few examples.

This is not to say that political parties should not segment the electorate or make use of the "types" developed by market research companies. Not all voters are amenable to changing their mind so reaching out to voters who are not open to voting for the party you represent is a waste of campaign resources, making some form of segmentation necessary. However, when trying to identify the voters who are open to changing their mind, the voter "type"

approach is questionable. It seems to consist in amalgamating context-specific, demographic, geographical and political factors to propose distinct categories of swing voters. We do not seek to bring a definitive answer to this debate but to highlight the issues inherent to the different conceptualisations of swing voting.

Limitations to the present research

Our research presents certain limitations which we discuss in turn.

In our first study, we only looked at switching patterns between two elections to try to identify psychological correlates of swing voting. We did this because we were interested in tracing the psychological correlates that underpinned the swing of mainstream party voters to UKIP in the years that preceded the 2016 Brexit vote. However, a more systematic way to establish the psychological correlates of swing voting would be to repeat our approach for all the elections that we have available data on. This would allow us to test whether some variables predict swing voting consistently across elections. Because the inclusion of many of the psychological variables in the BES panel survey are relatively recent, this would still be limited in scope but would include the 2017 and 2019 (and soon the 2024) elections, the 2019 election having been marked by high levels of electoral volatility.

Moreover, as we previously caveated, the abbreviated measure of personality that our findings on openness were derived from – the TIPI- comes at the cost of loss of complexity and granularity. To better understand the association between swing voting and openness, a more extensive battery of items such as the BFI or the NEO questionnaires is needed. These could help us see which openness facets are distinctive of swing voters and better account for

variance in switching patterns than our TIPI-based models. Furthermore, the Big 5 personality measures that we employed in our first study contain a more fundamental limitation in the fact that they are self-reported measures. Respondents were asked to rate if they saw themselves as "open to new experiences, complex" or as "conventional, uncreative". Respondents will be prone to desirability bias when providing such ratings (Hogan, 1996) as well as to self-deceptive biases that may lead them to give a distorted description of themselves which they honestly believe to be true (Paulhus et al., 1998). An alternative approach would be to use personality ratings made by spouses and peers (Costa and McCrae, 1992), although this comes with cost increases and limits to sample size as the experimenter would need to collect the data rather than relying on the free, open-source dataset of the BES.

In our second study, one limitation which we already discussed is that we explored a limited set of cognitive mechanisms that could have distinguished swing voters from other voters. By focusing our study on meta-cognition, confirmation bias and authoritarianism, we omitted other mechanisms which may be as important in shaping voting decisions. We discuss alternative candidate mechanisms in the next section.

In terms of the bias in the samples that we used, they were all drawn from the US and the UK. These two countries sit at the extreme ends of the scale of electoral volatility: the US because it currently has a historically low proportion of swing voters; the UK because it has a historically high proportion of them. The US constitute an atypical case for the study of swing voters because the proportion of swing voters in the overall US electorate has fallen to a record low in recent years (Smidt, 2017). In consequence, their importance in deciding elections has also fallen although, as discussed in the Introduction, this remains a debated

issue. In other democracies around the world, swing voters still represent a greater proportion of the electorate and are the leading force in electoral change (Mellon, 2021). The UK presents the inverse scenario compared to the US. The general elections we studied were at the beginning of a period of dramatic political realignment during which electoral volatility reached a historical high with record numbers of voters switching parties.

Moreover, our samples are drawn from Western, educated, industrialized, rich, and democratic countries, also referred to as WEIRD (Henrich et al., 2010). The fact that they are democratic is unavoidable, as swing voters only exist in democratic countries. However, the initial goal of this research was to verify the existence of psychological, cognitive and neural correlates of swing voting, and, in the ideal scenario, of identifying correlates that are generalisable to all countries, independently from their level of educational and economic development. We believe that our findings should be generalisable as openness, authoritarianism, meta-cognition and confirmation bias have no known, consistent dependency on education, income or industrialisation. Nevertheless, samples drawn from different countries would have strengthened our findings' claims to generalisability. Another issue related to the sample is that the BES, although one of the most representative data sets available in the UK, relies on similar sampling methods to many of the polling companies that mispredicted several recent elections, for example the 2016 US presidential election and the 2015 UK general elections.

Avenues for future research

The research undertaken in this thesis advances our understanding of swing voter psychology but it also shows how limited this understanding is and the next steps one might take to shed light on the individual-level psychological and cognitive causes of electoral volatility.

One approach that holds particular promise is the theoretical framework of psychological exploration and exploitation. The application of this framework to consumer psychology has shown that supermarket shoppers tend to be in a state of exploitation when shopping at the supermarket because they tend to always buy the same products. This has led industry specialists (AMV BBDO, 2007) to label this behaviour "sleep shopping" as most consumers' behaviour is automatic and unconscious. AMV BBDO, a creative agency, found that it was possible to break shoppers' exploitative behaviour and foster explorative behaviour in the form of new product purchases by disrupting their environment. Shotton et al. (2018) further investigated the causal link between disruption and the adoption of exploratory behaviours. They looked at the brand purchasing choices of consumers who had recently experienced a disruption in the form of a major life event, which was broadly defined to include "getting a new job, starting university, having a baby or getting married" (Shotton et al., 2018, p. 34). The brand choices of these consumers were compared to those of consumers who had not recently experienced a major life event. The results indicated that among consumers who had not recently experienced a major life event, 8% on average switched brands, thus adopting an exploratory behaviour. This figure rose to 21% among consumers who had recently experienced a major life event. Voting behaviour can also be exploitative or exploratory. Some voters repeatedly vote for the same party while others try new parties out. In this perspective, swing voting constitutes an exploratory behaviour. Future research should test

whether “exploitative” voting habits are more likely to be disrupted by major life events affecting individual voters. There is already some evidence of this at the aggregate level. Electoral shocks that disrupt the habitual political environment, like the 2007 global financial crisis and substantial increases in immigration, are thought to underlie modern-day electoral volatility in the UK (Fieldhouse et al.,), which is the aggregate expression of many individual voters adopting an exploratory approach to voting. Testing whether major life events explains swing voting would mark a significant milestone in our understanding of the individual-level factors underlying electoral volatility. This further underscores the need to integrate psychological theoretical frameworks and methods into the study of swing voting.

Neuroscientific methods offer an approach which could improve our ability to predict aggregate swing voter behaviour. In recent years, neuroscientists (Knutson et al., 2018) have demonstrated the ability of fMRI neuroimaging to forecast real-world aggregate outcomes relying only on small samples of participants known as neuro-focus groups. The goals of these studies ranged from predicting the effectiveness of an ad campaign encouraging people to quit smoking (Falk et al. 2012) to forecasting which songs would become popular among teenagers and which fundraising appeals would be most successful (Berns & Moore, 2012). They found that activation in the nucleus accumbens (nAcc) was a consistent predictor of real-world behavioural outcomes and even outperformed behavioural measures in the accuracy of its predictions. The theoretical explanation for the ability of the nAcc to forecast behaviour is that it constitutes the first region to activate in the brain’s reward pathway, even before brain regions that integrate personal experience (Knutson et al., 2018). Therefore, nAcc activation constitutes a marker of gain and reward across individuals because it marks these affective signals before individual experience has been integrated into the neural response to a stimulus. Knutson et al. (2018) noted that only a “subset of the components that

produce individual choice generalize to forecast aggregate choice. The generalizable components may in turn afford more accurate forecasts of aggregate choice than individual choice itself" (p. 4). Our understanding of swing voter decision-making is rendered difficult by the fact that swing voters are undecided or unaware of their own voting intentions. The cognitive and neural components that produce swing voters' vote choices are difficult to map as we have limited evidence regarding the relative importance of their contributions. To our knowledge, neuro-forecasting has not yet been applied to predict the outcome of an actual election. Its most interesting application would be to forecast which parties swing voters will vote for. Swing voters are a major source of variance (and error) in electoral forecasts. Neuro-forecasting could make a significant contribution to polling by accounting for this variance which explicit-preference-based surveys are methodologically disadvantaged for.

Although our second study found no evidence of a distinct cognitive style for swing voters, it is possible that the meta-cognition task we used did not tap into the right cognitive mechanism that makes swing voters distinct from other voters. The results of our first study indicate another cognitive mechanism which could explain swing voter cognition and decision-making. We found that openness predicts swing voting in all directions. Openness to experience is associated with cognitive complexity and, because of this, we can assume that it is also associated with cognitive flexibility. Zmigrod et al. (2019) found that individuals holding extreme political views had lower cognitive flexibility compared to moderates. It would be interesting to test whether swing voters have higher cognitive flexibility compared to other voters. This hypothesis is plausible given the fact that they had higher openness to new experience than other voters, although the size of this effect was small. Moreover, the construct that Zmigrod et al. (2019) used to measure cognitive flexibility satisfies the methodological criteria that we had set out at the beginning of Chapter 2. It uses tasks that are

"scrubbed" of all political content and measure cognitive process rather than content. These tasks are the Remote Associations Task, the Alternative Uses Task and the Wisconsin Card Sorting Task, their results weighted to form an average measure of cognitive flexibility.

The Vth factor of personality, whose label has now been accepted as "Openness", was previously thought by some researchers to represent specific aspects of intelligence or intellect. Peabody et al. (1989) in fact labeled it as "Intellect" on the basis of traits such as perceptiveness, reflectiveness and intelligence which all loaded onto the factor. For this reason, it might be tempting to explore the relationship between swing voting and IQ, as this branch of personality research suggests there might be a link between the two. However, the majority of scholars concur that openness is "not a measure of intelligence and […] has only small positive correlations with measures of IQ and scholastic aptitude" (John et al., 1999, p. 21). This questions the theoretical basis that hypotheses linking swing voting with intelligence would rest upon.

Last but not least, it would be valuable for future research to be able to predict when the interaction between authoritarianism and normative threat, which we already discussed, leads to electoral swings. Such predictions are made difficult by the qualitative nature of normative threat and the variation in subjective perceptions of threat which are likely to be significant within the electorate. Nevertheless, given the theory, voters high on authoritarianism should swing to the far right when perceived "threat toward cultural values, social norms or to society in general" (Buchanan, 2023, p. 138) are salient in news sources during an election campaign. Such threat can take many shapes: a marked increase in immigration, terrorist attacks, riots with damages to property and violent protests to name but a few. These predictions are testable and would improve our understanding of voting behaviour.

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Appendices

Table of contents

Appendix – Chapter 1

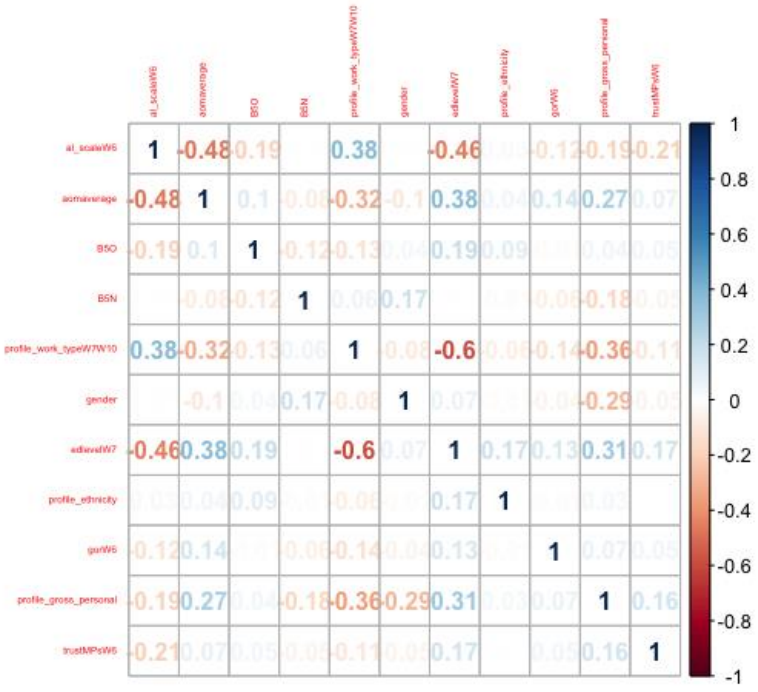
Probability of switching for different levels of authoritarianism and trust in MPs

Authoritarianism level	1	2	3	4	5	6	7	8	9	10
Labour voters	0.7%	1.1%	1.6%	2.3%	3.4%	4.8%	6.9%	9.7%	13.6%	18.7%
N	124	319	418	535	693	704	808	603	406	205
Conservative voters	3.9%	4.7%	5.7%	6.9%	8.2%	9.8%	11.8%	14%	16.5%	19.4%
N	9	37	136	325	681	1130	1727	1424	1005	320
Liberal Democrat voters	3.1%	4.7%	7%	10.4%	15.2%	21.6%	29.8%	39.5%	50.1%	60.7%
N	41	106	169	234	294	274	290	203	163	59

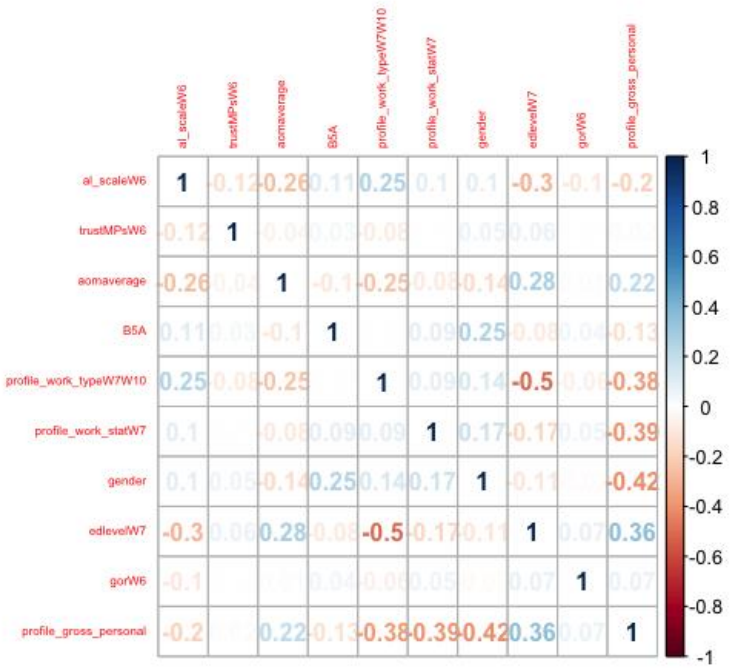
Level of trust in MPs	1	2	3	4	5	6	7
Labour voters	8%	6.3%	4.9%	3.8%	2.9%	2.3%	1.7%
N	748	890	1024	1161	1097	284	62
Conservative voters	58%	39.3%	23.2%	12.4%	6.2%	3%	1.4%
N	515	689	993	1676	2289	879	137
Liberal Democrat voters	34.4%	26.9%	20.5%	15.3%	11.3%	8.17%	5.9%
N	327	391	405	406	354	97	12
All Voters	57.8%	50.3%	42.9%	35.9%	29.4%	23.6%	18.7%
N	3157	3868	4277	5264	5279	1643	290

Correlation matrices of pairwise correlations between predictors

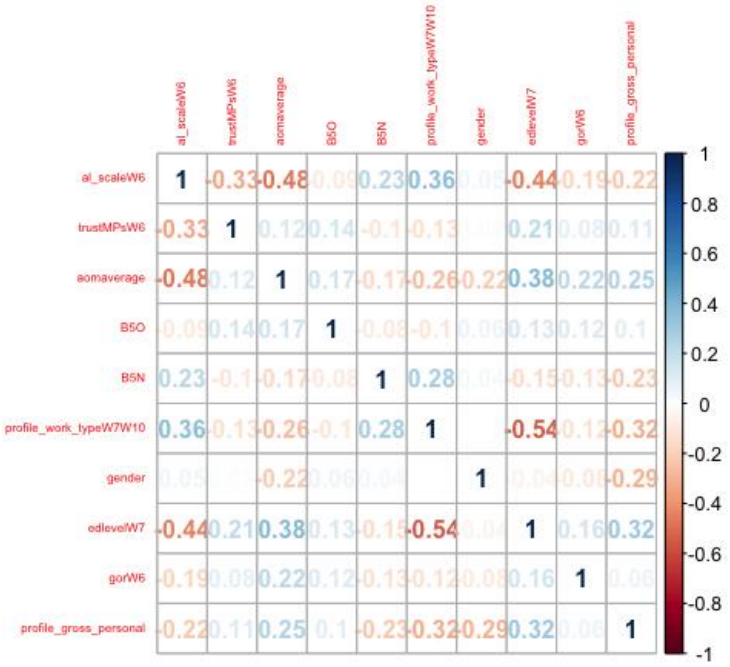
Labour voters



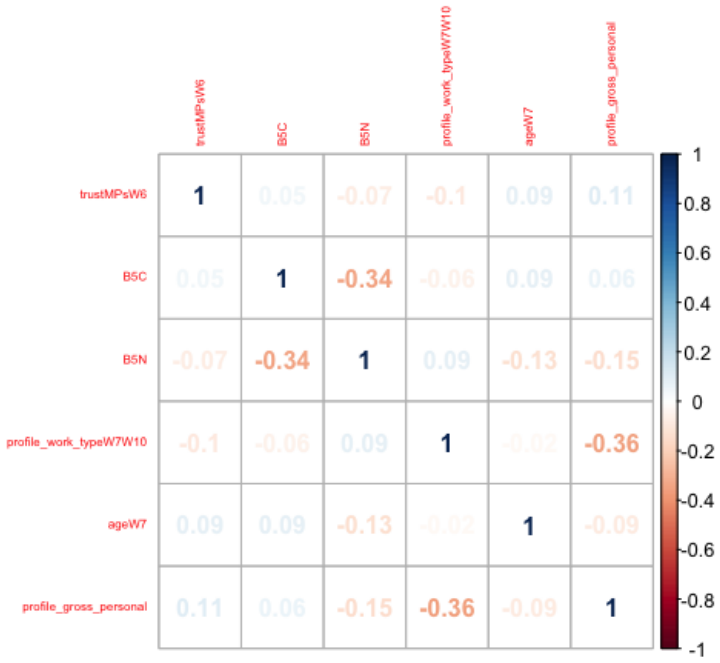
Conservative voters



Liberal Democrat voters



All voters



Appendix – Chapter 3

Figure S1: Grand average waveforms and scalp maps for Economy issues

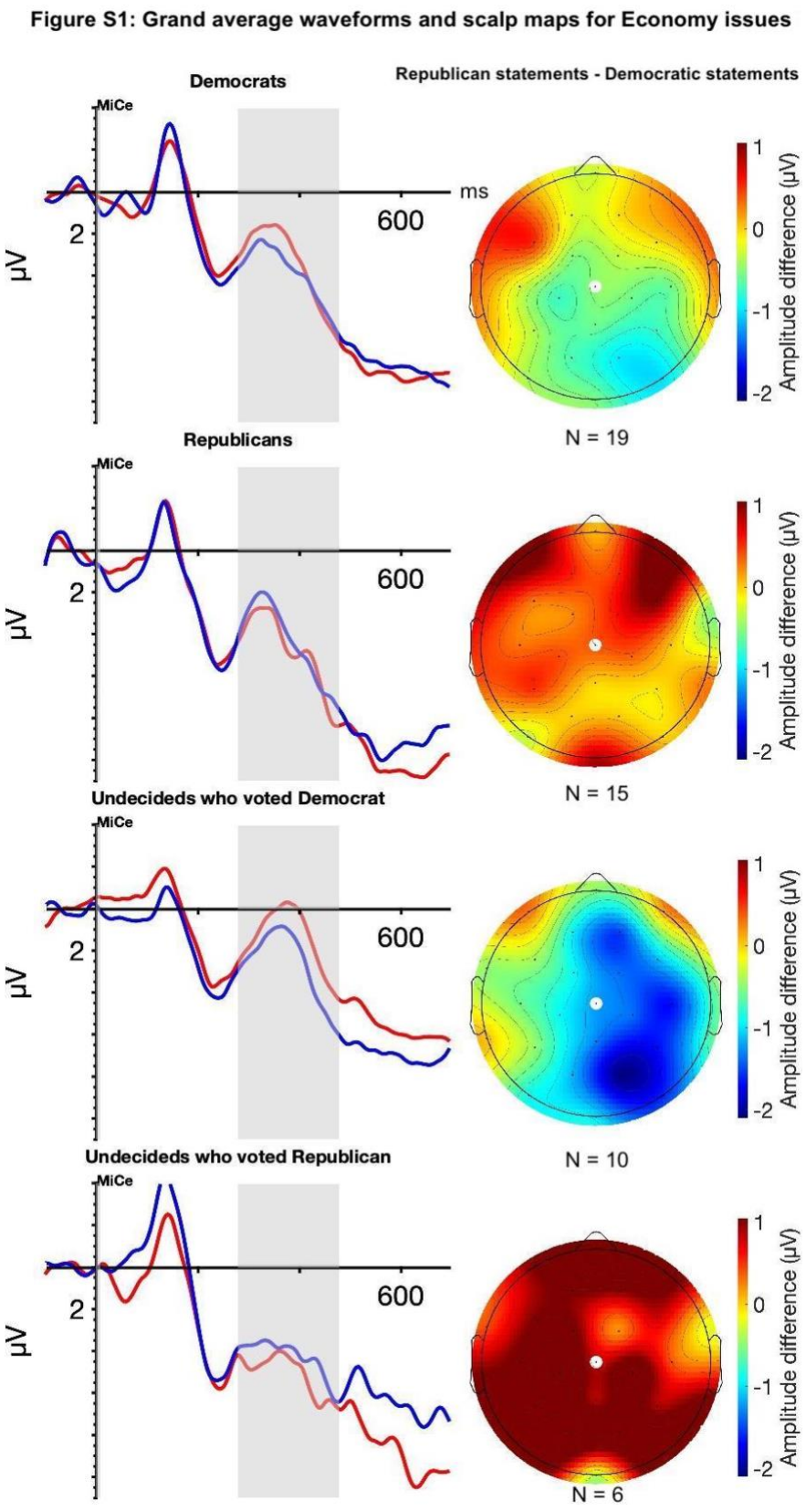


Figure S1. N400 response to statements on Economic issues. The waveforms on the left show the grand averaged waveforms for statements with Democratic (in blue) and Republican (in red) target words. All waveforms are from the vertex electrode MiCe which is indicated by a white dot on the scalp maps. The gray overlay shows the time window used for statistical analyses (278ms – 478 ms). The scalp maps on the right show the scalp distribution of the ERP difference (Republican - Democratic statements) as isovoltage in microvolts.

Figure S2: Grand average waveforms and scalp maps for Immigration issues

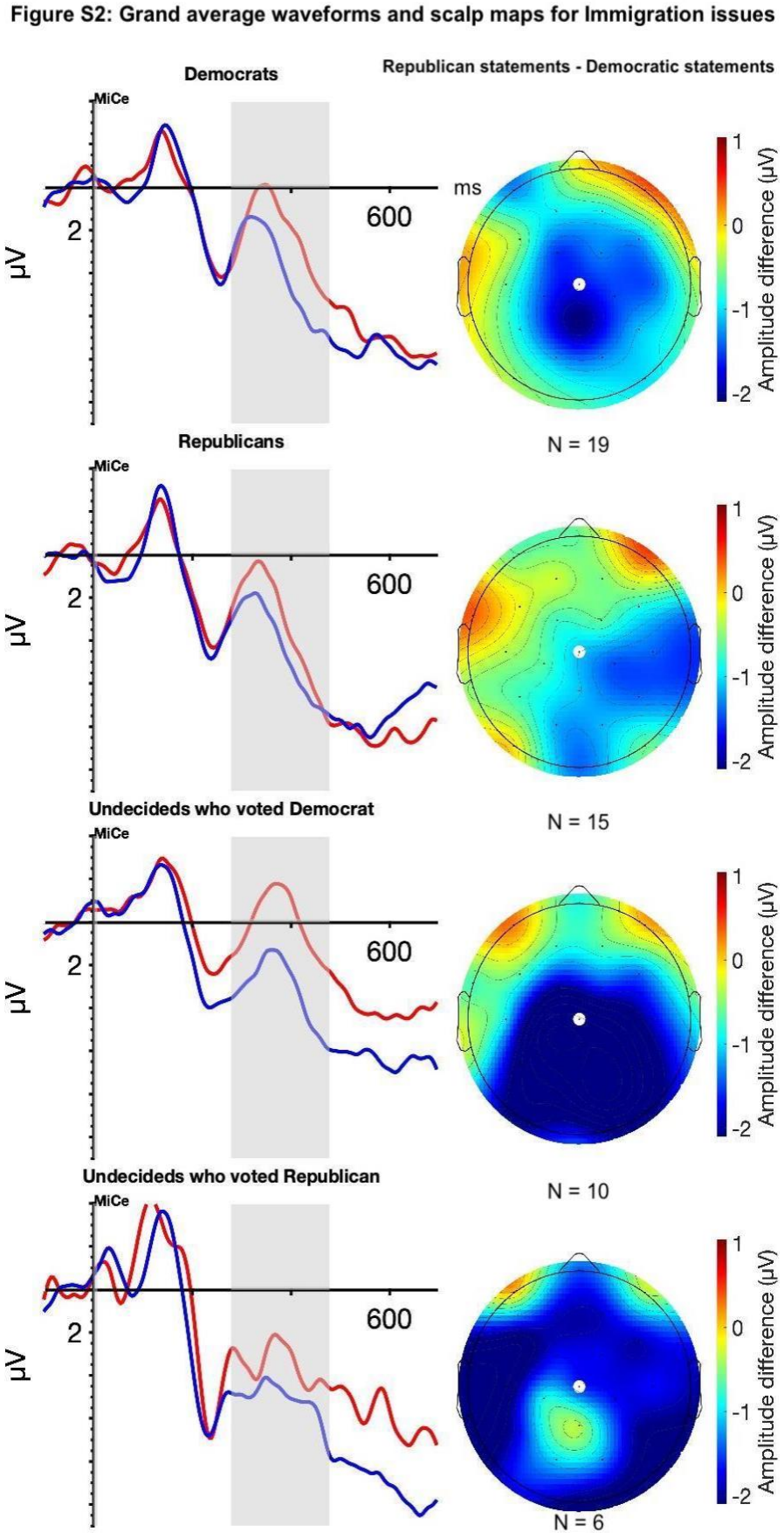


Figure S2. N400 response to statements on Immigration issues. The waveforms on the left show the grand averaged waveforms for statements with Democratic (in blue) and Republican (in red) target words. All waveforms are from the vertex electrode MiCe which is indicated by a white dot on the scalp maps. The gray overlay shows the time window used for statistical analyses (278ms – 478 ms). The scalp maps on the right show the scalp distribution of the ERP difference (Republican - Democratic statements) as isovoltage in microvolts.

Figure S3: Grand average waveforms and scalp maps for Societal issues

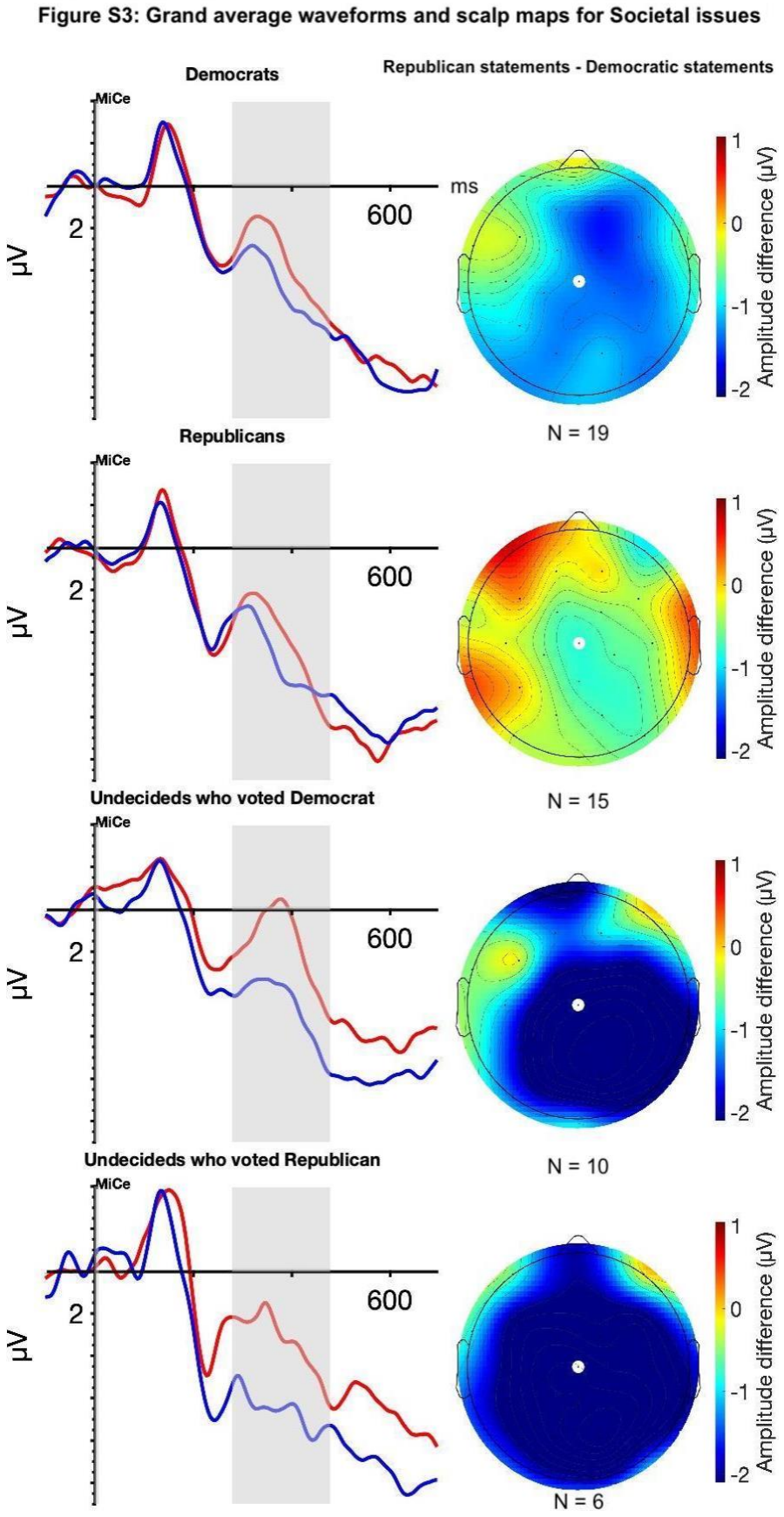


Figure S3. N400 response to statements on Societal issues. The waveforms on the left show the grand averaged waveforms for statements with Democratic (in blue) and Republican (in red) target words. All waveforms are from the vertex electrode MiCe which is indicated by a white dot on the scalp maps. The gray overlay shows the time window used for statistical analyses (278ms – 478 ms). The scalp maps on the right show the scalp distribution of the ERP difference (Republican - Democratic statements) as isovoltage in microvolts.

Figure S4: Grand average waveforms and scalp maps for General issues

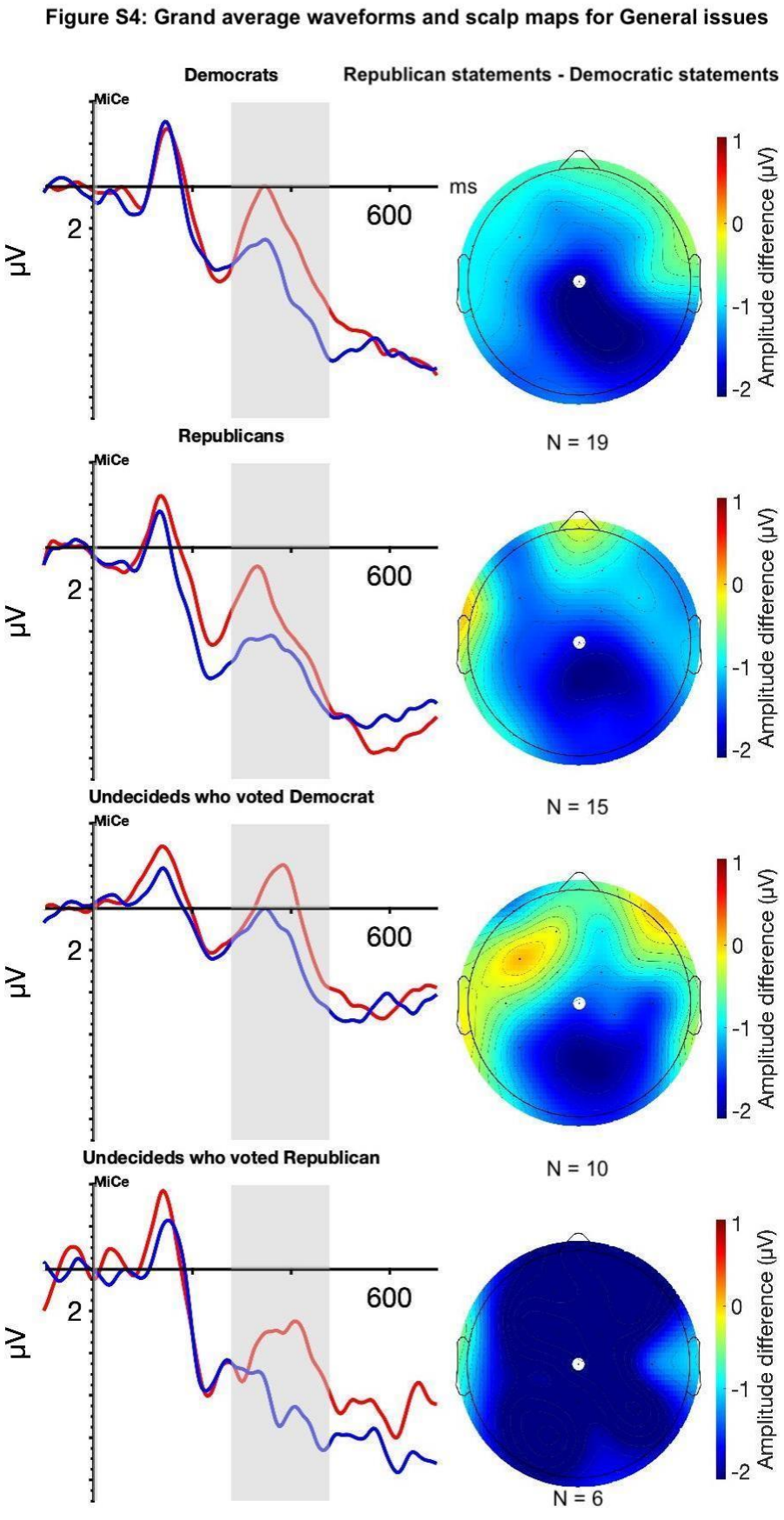


Figure S4. N400 response to statements on General issues. The waveforms on the left show the grand averaged waveforms for statements with Democratic (in blue) and Republican (in red) target words. All waveforms are from the vertex electrode MiCe which is indicated by a white dot on the scalp maps. The gray overlay shows the time window used for statistical analyses (278ms – 478 ms). The scalp maps on the right show the scalp distribution of the ERP difference (Republican - Democratic statements) as isovoltage in microvolts.

Figure S5: Grand averaged waveforms - Democrats

Figure S5

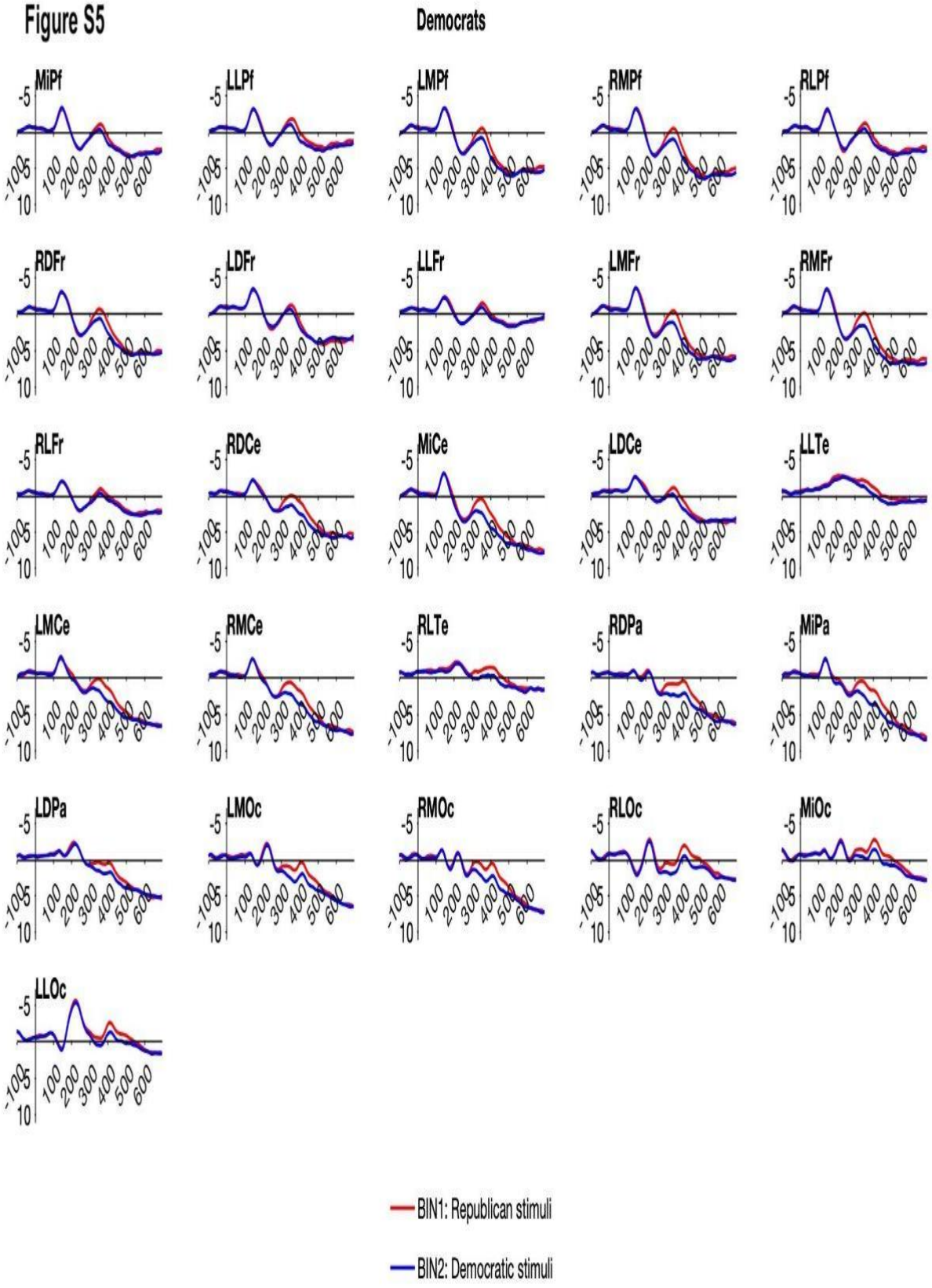

Democrats
MiPf
LLPf
LMPf
RMPf
RLPf
RDFr
LDFr
LLFr
LMFr
RMFr
RLFr
RDCe
MiCe
LDCe
LLTe
LMCe
RMCe
RLTe
RDPa
MiPa
LDPa
LMOc
RMOc
RLOc
MiOc
LLOc
-5
10
-100
100
200
300
400
500
600
BIN1: Republican stimuli
BIN2: Democratic stimuli

Figure S5 shows the grand averaged waveforms of decided Democratic participants. Democratic statements are in blue and Republican statements in red. Waveforms are shown for every electrode from -100ms to 600ms. Please refer to supplementary figure S9 for the electrode site location.

Figure S6: Grand averaged waveforms - Republicans

Figure S6

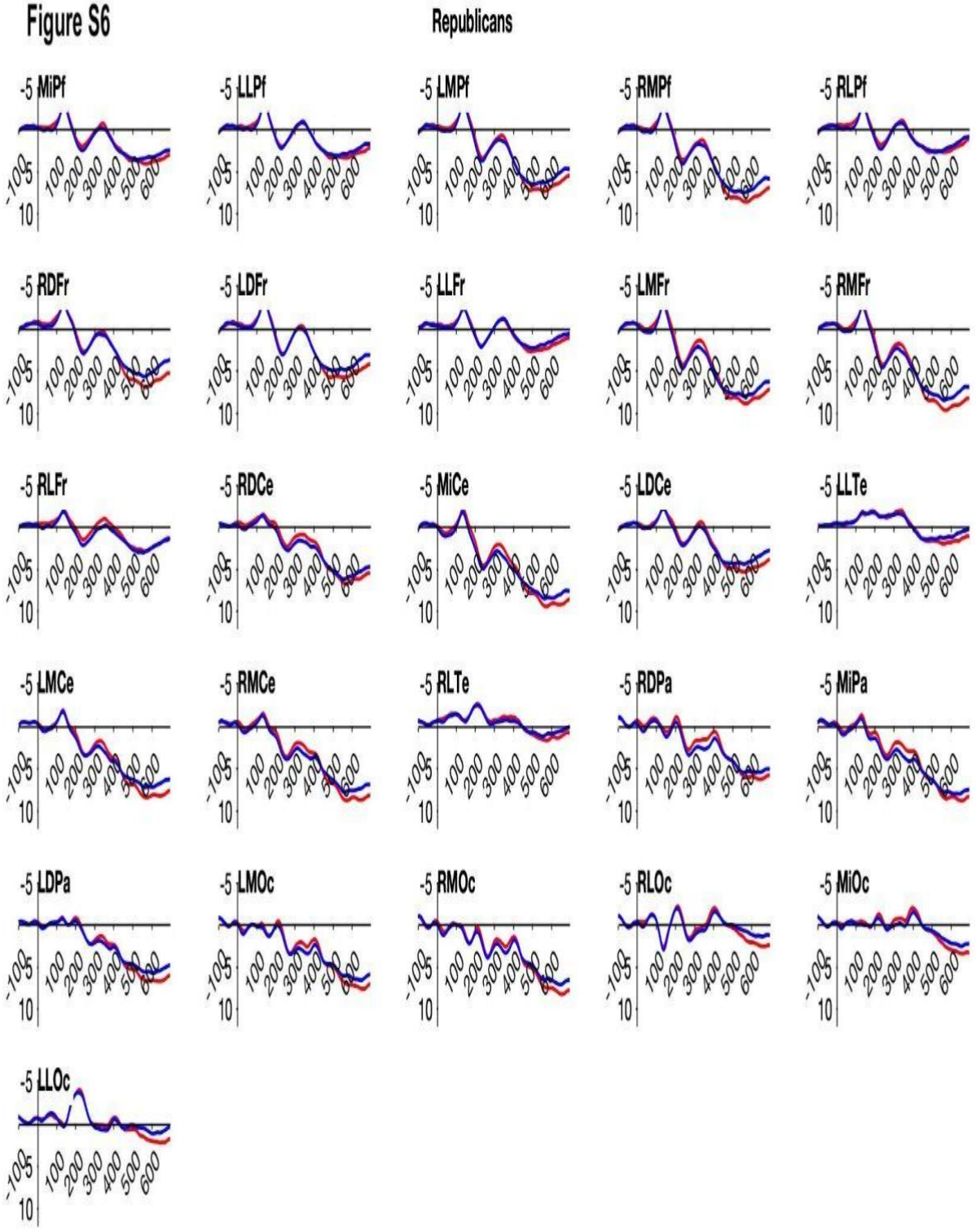

Republicans
-5 MiPf
-5 LLPf
-5 LMPf
-5 RMPf
-5 RLPf
-5 RDFr
-5 LDFr
-5 LLFr
-5 LMFr
-5 RMFr
-5 RLFr
-5 RDCe
-5 MiCe
-5 LDCe
-5 LLTe
-5 LMCe
-5 RMCe
-5 RLTe
-5 RDPa
-5 MiPa
-5 LDPa
-5 LMOc
-5 RMOc
-5 RLOc
-5 MiOc
-5 LLOc
-100
100
200
300
400
500
600
10
BIN1: Republican stimuli
BIN2: Democratic stimuli

Figure S6 shows the grand averaged waveforms of decided Republican participants. Democratic statements are in blue and Republican statements in red. Waveforms are shown for every electrode from -100ms to 600ms. Please refer to supplementary figure S9 for the electrode site location.

Figure S7: Grand averaged waveforms – Undecided voters who voted Democrat

Figure S7

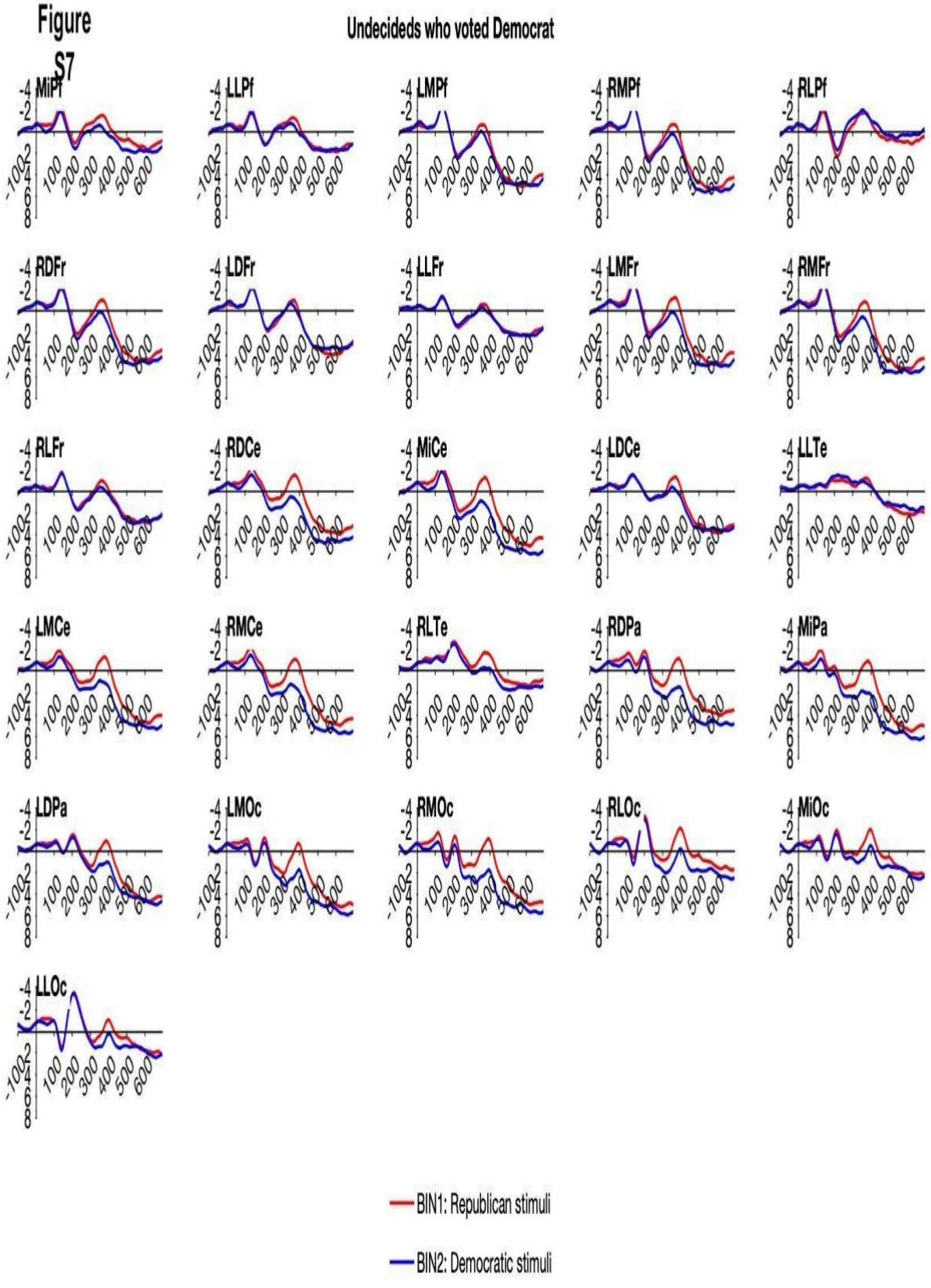

Undecideds who voted Democrat
MiPf
LLPf
LMPf
RMPf
RLPf
RDFr
LDFr
LLFr
LMFr
RMFr
RLFr
RDCe
MiCe
LDCe
LLTe
LMCe
RMCe
RLTe
RDPa
MiPa
LDPa
LMOc
RMOc
RLOc
MiOc
LLOc
BIN1: Republican stimuli
BIN2: Democratic stimuli

Figure S7 shows the grand averaged waveforms of undecided participants who voted for the Democratic party. Democratic statements are in blue and Republican statements in red. Waveforms are shown for every electrode from -100ms to 600ms. Please refer to supplementary figure S9 for the electrode site location.

Figure S8: Grand averaged waveforms – Undecided voters who voted Republican

Figure S8

Undecideds who voted Republican

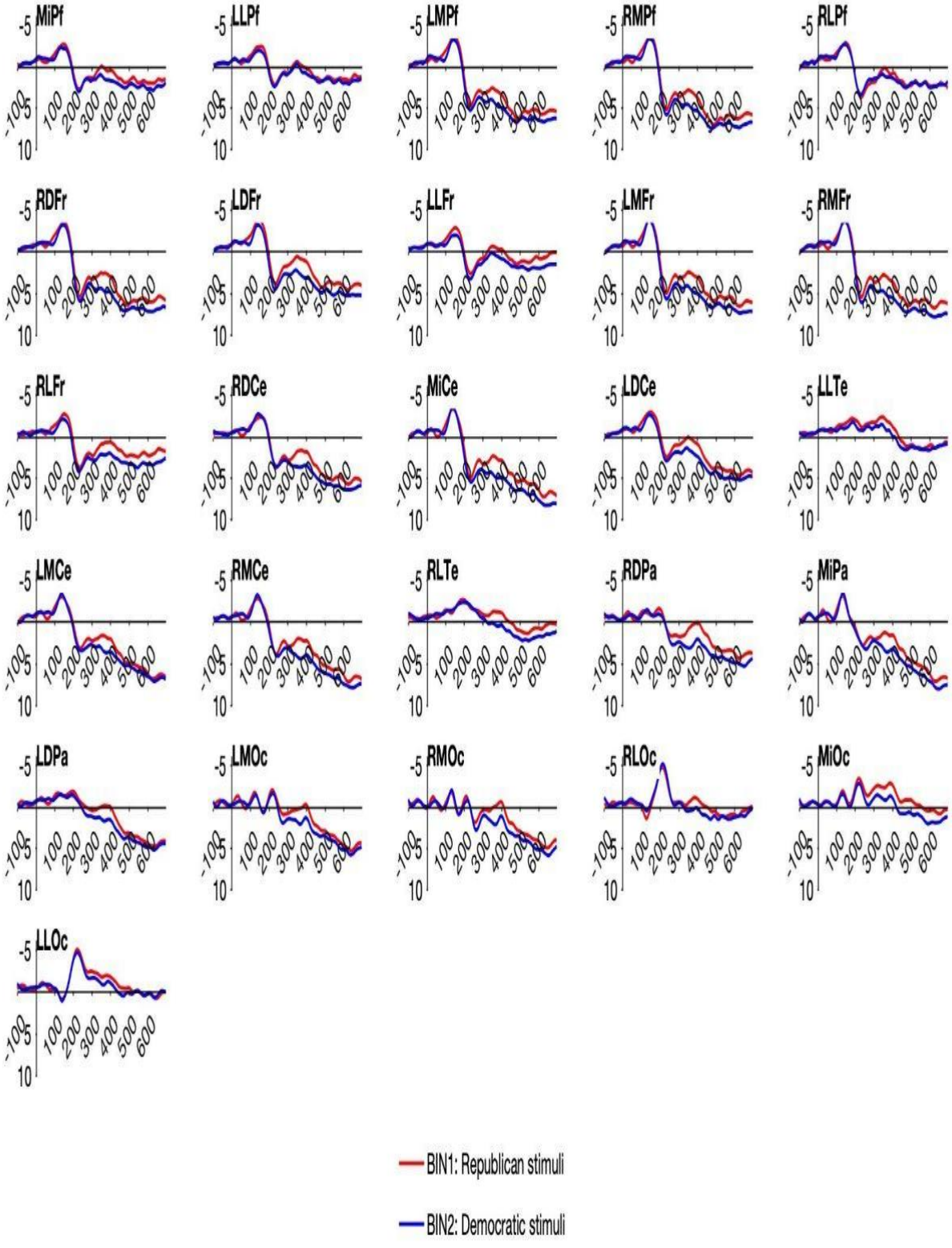


Figure S8 shows the grand averaged waveforms of undecided participants who voted for the Republican party. Democratic statements are in blue and Republican statements in red. Waveforms are shown for every electrode from -100ms to 600ms. Please refer to supplementary figure S9 for the electrode site location.

Figure S9: Kutas electrode array

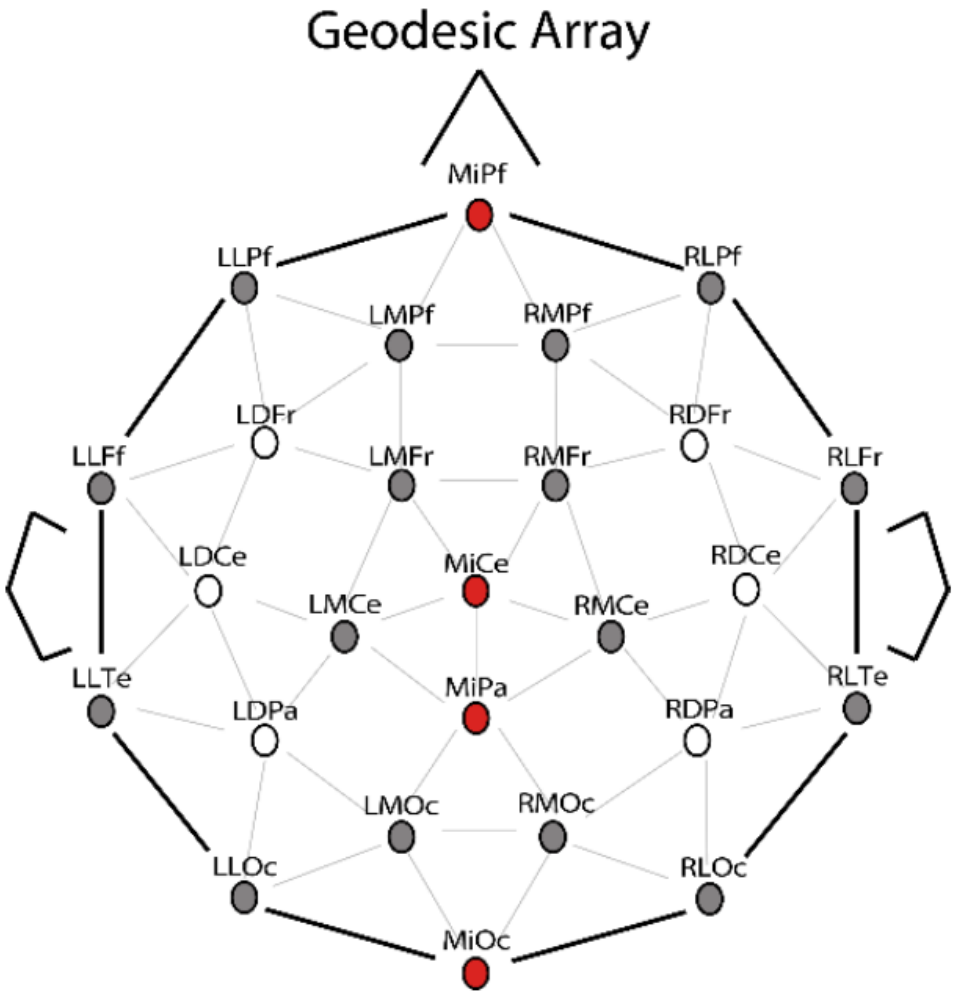


Figure S9 shows the Kutas electrode array used in this experiment. All 26 electrodes shown were used for the omnibus ANOVA. Electrodes in gray were used for the distributional analysis. Copyright: Nicole Y.Y. Wicha

Figure S10: EPI-N400 quadrant for Economic issues

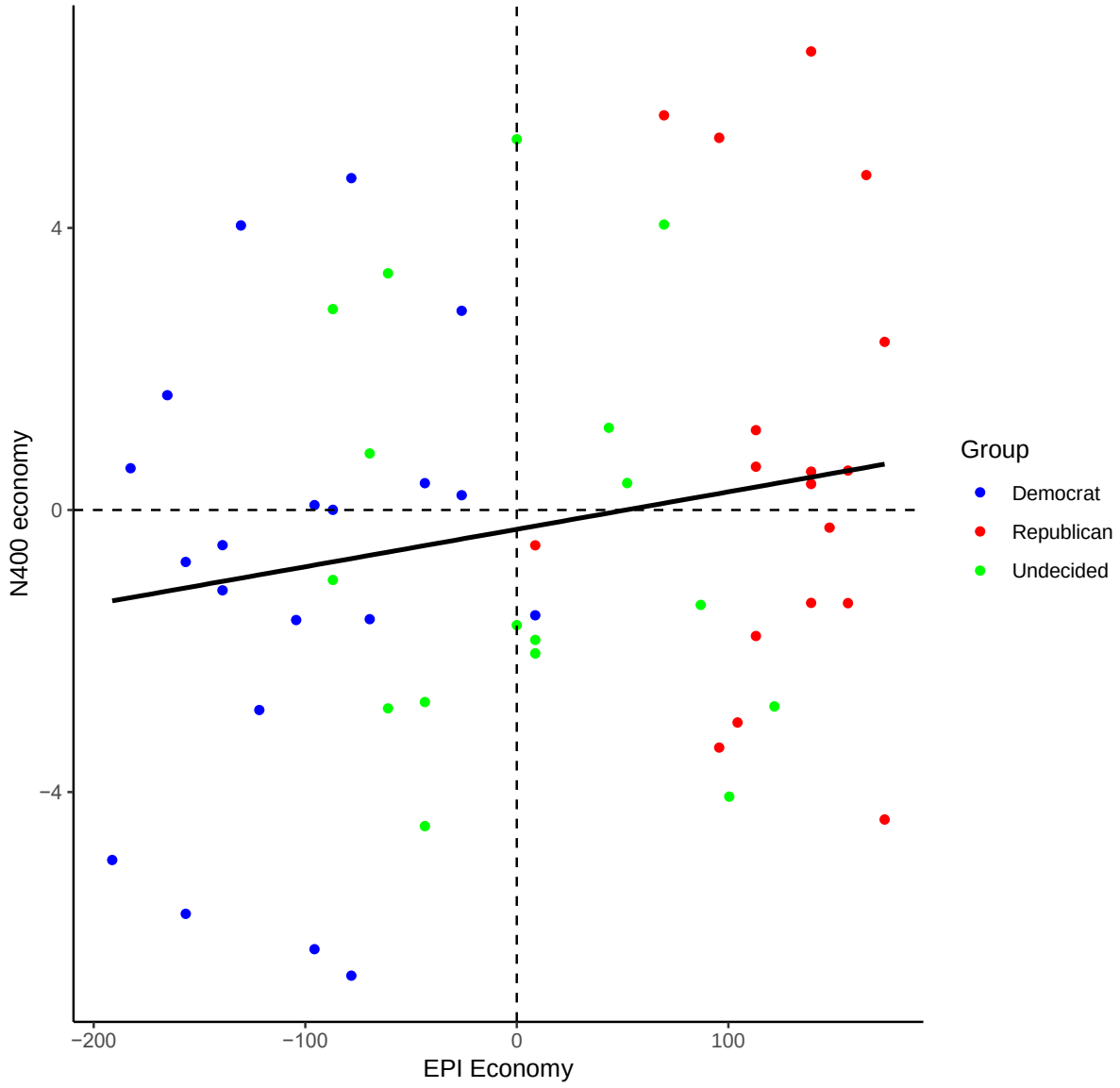


Figure S10. Individual participants are shown with their respective N400 effect values (in µV) for Economic issues and EPI scores for Economic issues. The black line shows the regression line when regressing the N400 effect on the EPI score.

Figure S11: EPI-N400 quadrant for Immigration issues

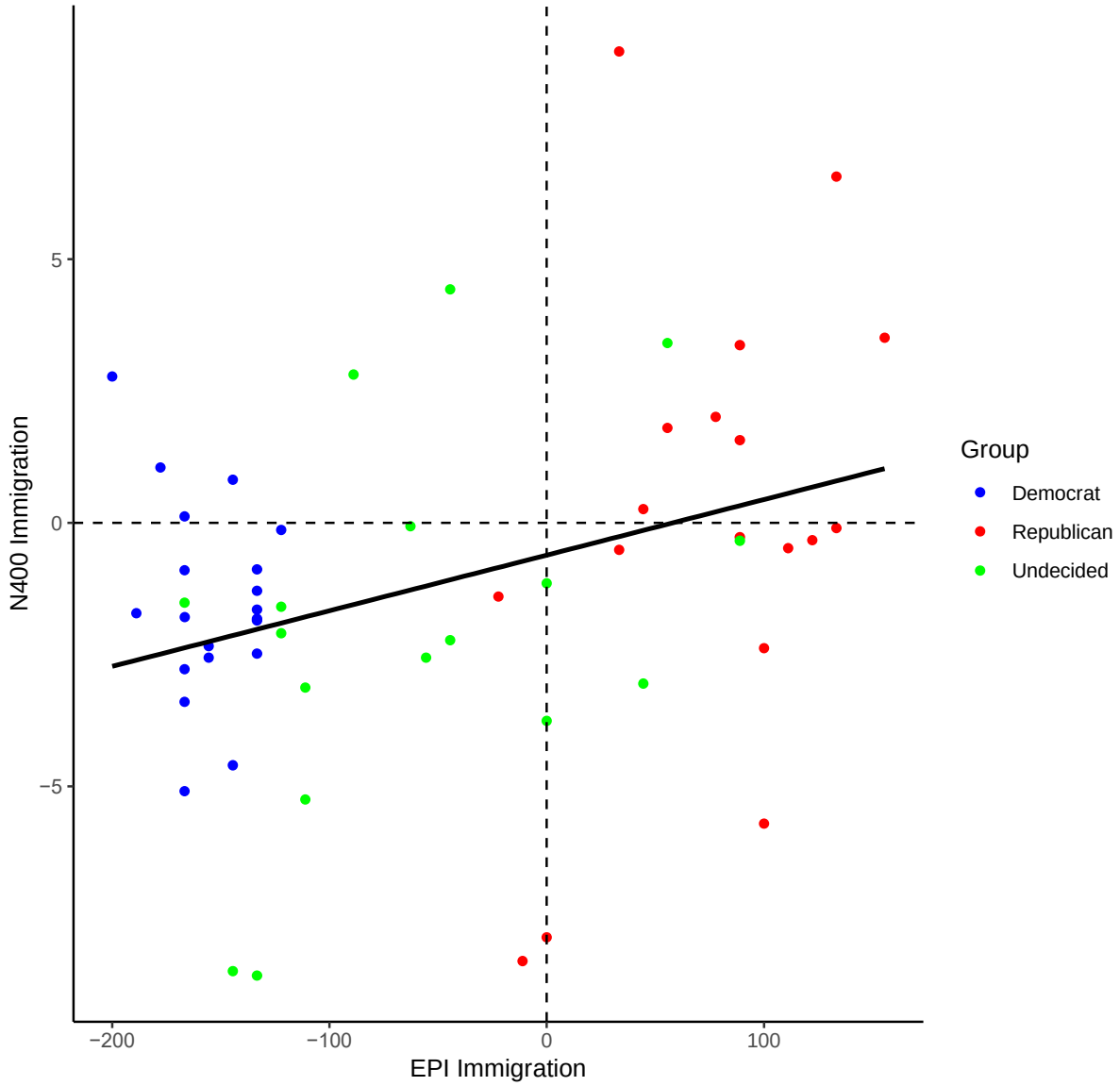


Figure S11. Individual participants are shown with their respective N400 effect values (in µV) for Immigration issues and EPI scores for Immigration issues. The black line shows the regression line when regressing the N400 effect on the EPI score.

Figure S12: EPI-N400 quadrant for Societal issues

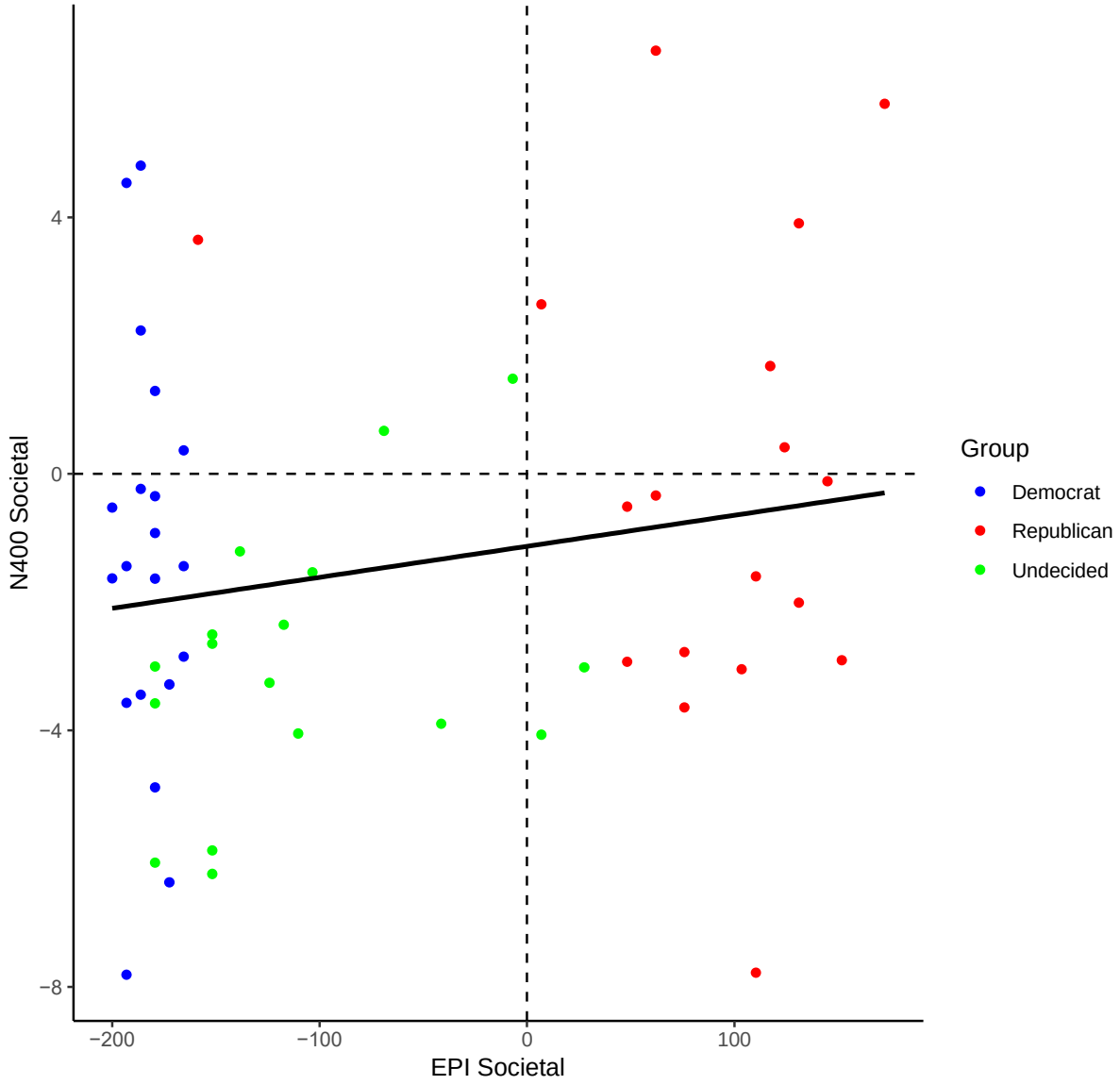


Figure S12. Individual participants are shown with their respective N400 effect values (in μV) for Societal issues and EPI scores for Societal issues. The black line shows the regression line when regressing the N400 effect on the EPI score.

Table S13. Mean amplitude: Electrode by Statement Type

	Pre-frontal					Frontal						Temporal	
Electrode	LLPf	LMPf	RMPf	RLPf	MIPf	LDFr	LMFr	RMFr	RDFr	LLFr	RLFr	LLTe	RLTe
Democratic statements	0.99	3.52	3.91	0.95	1.54	2.31	4.22	4.48	3.15	0.96	1.38	-0.05	0.49
Republican statements	0.58	2.83	3.16	0.81	1.06	1.94	3.14	3.44	2.34	0.76	0.86	-0.39	-0.23

	Central					Parietal			Occipital				
Electrode	LDCe	LMCe	MICe	RMCe	RDCe	LDPa	MIPa	RDPa	LLOc	LMOc	RMOc	RLOc	MIOc
Democratic statements	1.97	3.73	4.39	4.03	2.96	2.58	4.03	3.15	0.56	3.17	3.07	1.00	0.07
Republican statements	1.33	2.62	3.05	2.75	1.84	1.70	2.56	1.81	-0.15	1.96	1.74	-0.05	-0.87

Table S14. Mean amplitude N400 effect (Republican minus Democratic statements) for all statements (Overall N400) and for Economy statements alone (in μV). Note that two participants had insufficient trials for the Economy issue dimension and were excluded.

	Overall N400			N400 Economy		
	Mean	Range	N	Mean	Range	N
Democratic voters	-1.6	-4.49, 2.18	20	-0.65	-6.23, 4.71	19
Republican voters	-0.76	-2.81, 3.07	18	0.20	-4.39, 6.50	15
Undecided voters	-1.79	-4.35, 0.92	17	-0.30	-4.48, 5.26	16

S15: Additional information on the five participants excluded from Issue Dimension-specific analyses

We include the respective numbers of valid trials by statement type and issue dimension for the five participants who did not meet the threshold of 14 valid trials and were excluded from issue dimension-specific analyses:

First participant excluded:

Republican Economy Statements, Trial Count: 13

Democratic Economy Statements, Trial Count: 12

Republican Immigration Statements, Trial Count: 10

Democratic Immigration Statements, Trial Count: 13

Republican Societal Statements , Trial Count: 19

Democratic Societal Statements , Trial Count: 16

Second participant excluded:

Republican Economy Statements, Trial Count: 11

Democratic Economy Statements, Trial Count: 13

Republican Immigration Statements, Trial Count: 11

Democratic Immigration Statements, Trial Count: 11

Republican Societal Statements , Trial Count: 9

Democratic Societal Statements , Trial Count: 16

Third participant excluded:

Republican Economy Statements, Trial Count: 20

Democratic Economy Statements, Trial Count: 21

Republican Immigration Statements, Trial Count: 11

Democratic Immigration Statements, Trial Count: 15

Republican Societal Statements , Trial Count: 23

Democratic Societal Statements , Trial Count: 24

Fourth participant excluded:

Republican Economy Statements, Trial Count: 16

Democratic Economy Statements, Trial Count: 7

Republican Immigration Statements, Trial Count: 8

Democratic Immigration Statements, Trial Count: 11

Republican Societal Statements , Trial Count: 12

Democratic Societal Statements , Trial Count: 11

Fifth participant excluded:

Republican Economy Statements, Trial Count: 10

Democratic Economy Statements, Trial Count: 9

Republican Immigration Statements, Trial Count: 8

Democratic Immigration Statements, Trial Count: 8

Republican Societal Statements , Trial Count: 13

Democratic Societal Statements , Trial Count: 18

Practice trials

I think the second amendment of the Constitution should be changed.

Social distancing measures to avoid catching covid should now be stopped.

The governor's answer to rising crime should be spending on education.

Environmental legislation is a way for the government to introduce taxes.

Allowing people to carry guns without a background check is dangerous.

I think that politicians who support sanctuary cities should be prosecuted.

The price of certain prescription drugs like insulin should be capped.

What Texas workers need to uphold their dignity is fewer taxes.

To those who receive them vaccines against covid-19 offer considerable protection.

The main beneficiary of the Inflation Reduction Package is the IRS.

Statements

On the matter of drugs I want marijuana to be legalized/criminalized.

In terms of the services it provides government should be bigger/smaller.

We see an immigration crisis because of the policies of Abbott/Biden.

The profit made by business corporations in the US is excessive/fair.

I think that a government run healthcare system would limit inequalities/choices.

Speaking of the distribution of wealth America should have fewer billionaires/socialists.

Soaring prices and inflation will be dealt with by a Democrat/Republican.

In their contribution to American culture immigrants bring American values/harm.

The people who stormed the Capitol on January 6th were thugs/patriots.

In my opinion, the Texas State abortion ban should be repealed/maintained.

Taxpayer money spent on policing the border with Mexico is wasted/needed.

To prevent killings in Texas we should have more gun restrictions/sales.

The Justice Department's inquiry into Donald Trump's Florida home is warranted/unfair.

President Joe Biden's economic policies have led to increases in growth/prices.

I think raising the minimum wage would lead to job gains/losses.

It's my belief that man made climate change is a threat/hoax.

The Biden administration has pursued economic policies that resulted in jobs/inflation.

The government should make birth control pills for women more available/unavailable.

Governor Abbott's management of the covid-19 pandemic has been a failure/success.

When they try to enter the US immigrants should be welcomed/stopped.

The way governor Abbott deals with gun violence has my disapproval/approval.

When responding to the pandemic, stay at home orders were right/wrong.

Tax rates on the highest incomes in America should be raised/lowered.

The state governor should treat unauthorized immigrants in Texas as refugees/felons.

For energy generation, Texas should invest a lot more in renewables/gas.

Sending illegal immigrants from Texas to Washington by bus is wrong/right.

The candidate who will keep Texas rural hospitals open is Beto/Abbott.

For US society a greater acceptance of transgender people is moral/immoral.

In the economic policies he pursued, governor Abbott has driven inflation/growth.

The real culprit of the Southern border crisis is the governor/president.

The increased public focus on the history of slavery is welcome/unwelcome.

My own views on the Black Lives Matter movement are positive/negative.

I think the governor who will support law enforcement is Beto/Abbott.

Free public healthcare for Texan families and individuals is a right/trap.

I think that gun control laws and regulations should be tightened/loosened.

The committee investigating the January 6th incident is pursuing the truth/witchhunt.

Over the years the energy industry in Texas has brought pollution/prosperity.

I think that emergency measures to combat illegal immigration are unnecessary/necessary.

Building a wall on the entire border with Mexico is wrong/wise.

The labor shortages in this country could be filled by migrants/Americans.

Security and public order is an issue best handled by Democrats/Republicans.

The Democrats' economic agenda will lead the US economy to growth/recession.

On abortion, the most important rights are those of the woman/baby.

The Black Lives Matter protesters in 2020 were asking for justice/trouble.

The ownership of assault weapons like AR-15s needs to be restricted/protected.

Across the country Obamacare has made American families and individuals healthier/poorer.

I think affirmative action programmes for African Americans should be expanded/unfair.

We are all much better off with a president like Biden/Trump.

I personally think that sanctuary cities in Texas should be allowed/banned.

Building a wall at the border would make US more isolated/secure.

People who say that America has racist institutions have a point/problem.

Given how it handled BLM protests the police should be defunded/applauded.

Prices are rising and will keep doing so because of Abbott/Biden.

The decision to interrupt a pregnancy is something up to women/God.

When he left office, Donald Trump handled sensitive classified information inappropriately/appropriately.

In my opinion the country's economy is best handled by Democrats/Republicans.

Speaking about abortion, we need a governor who is pro- choice/pro- life.

Expanding Medicaid in Texas would make our state healthcare system better/worse.

I expect my representatives to confirm that abortion is a right/crime.

Opening America to people all over the world makes it stronger/weaker.

Under the Affordable Care Act, the quality of healthcare has improved/worsened.

I think imposing a minimum tax on large corporations is fair/unfair.

The covid restrictions that were imposed in the US were necessary/unnecessary.

Criminalising all abortions even in the case of rape is outrageous/right.

The fact that some people in America are billionaires is unfair/good.

Women crossing state lines to have an abortion should be helped/punished.

Under Joe Biden the price of gas has become considerably controlled/costlier.

Immigrants contribute to the Texas economy in a way that's positive/negative.

People who stormed the Capitol on January 6th should be prosecuted/thanked.

The ban on abortions in Texas is something I find appalling/good.

Forgiving student loans like President Joe Biden recently did is right/socialist.

Proof of vaccination against covid-19 for public employees should be mandatory/optional.

Federal and state funding for planned parenthood should be significantly increased/decreased.

When it interacts with African American citizens, the police is biased/fair.

The people who want to restrict gun rights are against violence/freedom.

Under Obamacare the cost of health insurance for ordinary people decreased/increased.

Creating a social safety net for the most vulnerable is important/socialist.

Letting people come across the Southern border with Mexico is humane/dangerous.

I strongly believe that the 2020 presidential election results were fair/rigged.

I think spending public money to welcome asylum seekers is right/wrong.

If they meet certain requirements illegal immigrants already here should stay/leave.

For Texans what a Republican/Democratic governor would mean is more unemployment.

Governor Greg Abbott's border operation Lone Star is a total failure/success.

The Republicans' economic agenda will lead the US economy to recession/growth.

By investigating Donald Trump, the Justice Department is doing its duty/witchhunt.

I think that affirmative action programs for African Americans are fair.

I think affirmative action programs for African Americans should be abolished.

I think that accepting LGBTQ people in our communities is right/wrong.

Red flag laws on gun purchases and background checks are needed/unconstitutional.

When it overturned Roe versus Wade the Supreme Court was wrong/right.

The death of George Floyd in 2020 was caused by hatred/accident.

The fact that Trump took classified information with him is outrageous/irrelevant.

I think the best protection we have against covid-19 is vaccines/freedom.

S17: Stimuli not covered by the Warriner et al. valence database

word	statement type	Valence
inequality	pro-Democratic	Negative
defund	pro-Democratic	Negative
renewable	pro-Democratic	Positive
repeal	pro-Democratic	Positive
legalise	pro-Democratic	Positive
American	pro-Republican	Positive
witchhunt	pro-Republican	Negative
witchhunt	pro-Republican	Negative
unconstitutional	pro-Republican	Negative
lower	pro-Republican	Negative
worsen	pro-Republican	Negative

Table S18. Stimuli valence

	Database word	Experimental stimulus	Statement type	Trial codes	Valence score
1	abolish	abolished	pro-Republican	138	3,84
2	accident	accident	pro-Republican	114	2,55
3	allow	allowed	pro-Democrat	60	6,39
4	appalling	appalling	pro-Democrat	106	2,95
5	applaud	applauded	pro-Republican	100	6,7
6	approval	approval	pro-Republican	90	6,75
7	appropriate	appropriately	pro-Republican	173	6,1
8	available	available	pro-Democrat	89	6,86
9	baby	baby	pro-Republican	124	6,67
10	bad	worse	pro-Republican	158	3,24
11	biased	biased	pro-Democrat	118	4,21
12	billionaire	billionaires	pro-Democrat	37	6
13	choice	choice	pro-Democrat	141	6,36
14	choice	choices	pro-Republican	157	6,36
15	control	controlled	pro-Democrat	22	4,43
16	costly	costlier	pro-Republican	46	3
17	criminal	criminalized	pro-Republican	86	2,11
18	crime	crime	pro-Republican	137	1,95
19	dangerous	dangerous	pro-Republican	68	2,33
20	decrease	decreased	pro-Democrat	164	4,16
21	disapproval	disapproval	pro-Democrat	133	3,4
22	duty	duty	pro-Democrat	182	5,33
23	excessive	excessive	pro-Democrat	5	4,37
24	expand	expanded	pro-Democrat	98	5,35
25	failure	failure	pro-Democrat	163	2,15
26	failure	failure	pro-Democrat	77	2,15
27	fair	fair	pro-Democrat	110	7,14
28	fair	fair	pro-Republican	41	7,14
29	fair	fair	pro-Republican	108	7,14
30	fair	fair	pro-Democrat	32	7,14
31	fair	fair	pro-Democrat	175	7,14
32	felon	felons	pro-Republican	54	2,2
33	freedom	freedom	pro-Republican	155	7,72
34	freedom	freedom	pro-Republican	135	7,72
35	gain	gains	pro-Democrat	27	5,9
36	gas	gas	pro-Republican	38	4,06
37	good	good	pro-Republican	127	7,89
38	good	good	pro-Republican	28	7,89
39	good	better	pro-Democrat	150	7,89
40	governor	governor	pro-Democrat	56	5,32
41	growth	growth	pro-Democrat	40	6

42	growth	growth	pro-Republican	31	6
43	growth	growth	pro-Democrat	16	6
44	growth	growth	pro-Republican	14	6
45	harm	harm	pro-Republican	72	1,91
46	hatred	hatred	pro-Democrat	122	2,38
47	healthy	healthier	pro-Democrat	166	7,76
48	help	helped	pro-Democrat	115	6,95
49	hoax	hoax	pro-Republican	29	3,85
50	humane	humane	pro-Democrat	64	6,88
51	immoral	immoral	pro-Republican	136	2,79
52	important	important	pro-Democrat	44	6,82
53	improve	improved	pro-Democrat	151	6,14
54	inappropriate	inappropriately	pro-Democrat	179	3,7
55	increase	increased	pro-Republican	154	5,9
56	increase	increased	pro-Democrat	107	5,9
57	inflation	inflation	pro-Republican	11	2,91
58	inflation	inflation	pro-Democrat	48	2,91
59	irrelevant	irrelevant	pro-Republican	183	3,35
60	isolate	isolated	pro-Democrat	70	4,35
61	justice	justice	pro-Democrat	129	6,8
62	leave	leave	pro-Republican	84	4,68
63	life	life	pro-Republican	102	6,68
64	loosen	loosened	pro-Republican	94	5
65	loss	losses	pro-Republican	9	2,9
66	maintain	maintained	pro-Republican	87	6,29
67	mandatory	mandatory	pro-Democrat	153	3,9
68	moral	moral	pro-Democrat	91	6,85
69	necessary	necessary	pro-Republican	57	5,39
70	necessary	necessary	pro-Democrat	159	5,39
71	need	needed	pro-Republican	74	5,45
72	need	needed	pro-Democrat	112	5,45
73	negative	negative	pro-Republican	93	2,52
74	negative	negative	pro-Republican	63	2,52
75	optional	optional	pro-Republican	160	5,76
76	outrageous	outrageous	pro-Democrat	177	4,19
77	outrageous	outrageous	pro-Democrat	126	4,19
78	patriot	patriots	pro-Republican	168	5,8
79	point	point	pro-Democrat	99	5,45
80	pollution	pollution	pro-Democrat	15	2
81	poor	poorer	pro-Republican	149	3,67
82	positive	positive	pro-Democrat	83	7,57
83	positive	positive	pro-Democrat	120	7,57
84	president	president	pro-Republican	85	5,23
85	price	prices	pro-Republican	8	4,94

86	problem	problem	pro-Republican	142	3,52
87	prosperity	prosperity	pro-Republican	42	7,1
88	prosecute	prosecuted	pro-Democrat	187	3,15
89	protected	protected	pro-Republican	130	7,05
90	punish	punished	pro-Republican	105	2,86
91	raise	raised	pro-Democrat	12	7,22
92	recession	recession	pro-Democrat	26	2,68
93	recession	recession	pro-Republican	33	2,68
94	refugee	refugees	pro-Democrat	82	4,68
95	restricted	restricted	pro-Democrat	97	3,83
96	restriction	restrictions	pro-Democrat	119	4
97	right	right	pro-Republican	113	7,32
98	right	right	pro-Democrat	34	7,32
99	right	right	pro-Democrat	117	7,32
100	right	right	pro-Republican	55	7,32
101	right	right	pro-Democrat	146	7,32
102	right	right	pro-Republican	104	7,32
103	right	right	pro-Democrat	103	7,32
104	right	right	pro-Democrat	71	7,32
105	right	right	pro-Democrat	148	7,32
106	sale	sales	pro-Republican	88	6,23
107	secure	secure	pro-Republican	61	7,08
108	small	smaller	pro-Republican	30	5,76
109	socialist	socialist	pro-Republican	23	4,11
110	socialist	socialist	pro-Republican	24	4,11
111	socialist	socialists	pro-Republican	6	4,11
112	stay	stay	pro-Democrat	66	6,14
113	stop	stopped	pro-Republican	69	4,73
114	strength	strength	pro-Democrat	51	6,73
115	strong	stronger	pro-Democrat	76	6,81
116	success	success	pro-Republican	145	7,49
117	success	success	pro-Republican	67	7,49
118	thank	thanked	pro-Republican	174	7,77
119	threat	threat	pro-Democrat	10	2,63
120	thug	thugs	pro-Democrat	180	2,52
121	tighten	tightened	pro-Democrat	131	5
122	trap	trap	pro-Republican	167	3,24
123	trouble	trouble	pro-Republican	96	2,87
124	truth	truth	pro-Democrat	171	7,19
125	unavailable	unavailable	pro-Republican	134	3,52
126	unemployment	unemployment	pro-Democrat	25	2,32
127	unemployment	unemployment	pro-Republican	36	2,32
128	unfair	unfair	pro-Democrat	21	3,15
129	unfair	unfair	pro-Republican	132	3,15

130	unfair	unfair	pro-Republican	181	3,15
131	unfair	unfair	pro-Republican	20	3,15
132	unnecessary	unnecessary	pro-Democrat	73	4,62
133	unnecessary	unnecessary	pro-Republican	152	4,62
134	unwelcome	unwelcome	pro-Republican	121	3,5
135	vaccine	vaccines	pro-Democrat	165	6,48
136	violence	violence	pro-Democrat	109	2,71
137	warrant	warranted	pro-Democrat	169	3,23
138	waste	wasted	pro-Democrat	52	2,61
139	weak	weaker	pro-Republican	62	2,95
140	welcome	welcomed	pro-Democrat	53	7,27
141	welcome	welcome	pro-Democrat	92	7,27
142	welcome	welcomed	pro-Democrat	53	7,27
143	welcome	welcome	pro-Democrat	92	7,27
144	wise	wise	pro-Republican	75	7,42
145	woman	woman	pro-Democrat	95	7,09
146	wrong	wrong	pro-Democrat	79	3,24
147	wrong	wrong	pro-Republican	156	3,24
148	wrong	wrong	pro-Republican	65	3,24
149	wrong	wrong	pro-Democrat	58	3,24
150	wrong	wrong	pro-Democrat	123	3,24
151	wrong	wrong	pro-Republican	111	3,24
152	ban	banned	pro-Republican	78	3,38
153	big	bigger	pro-Democrat	4	5,64
154	democrat	Democrat	pro-Democrat	43	5,54
155	democrat	Democrats	pro-Democrat	19	5,54
156	democrat	Democrats	pro-Democrat	186	5,54
157	god	God	pro-Republican	101	5,9
158	immigrant	migrants	pro-Democrat	81	5,43
159	job	jobs	pro-Democrat	35	5,64
160	republican	Republican	pro-Republican	7	4,26
161	republican	Republicans	pro-Republican	172	4,26
162	republican	Republicans	pro-Republican	45	4,26
163	rig	rigged	pro-Republican	178	4,32
164	woman	women	pro-Democrat	143	7,09

Note: valence scores were taken from the Warriner et al. database

Figure S19. EPI scores for Democratic, Republican and undecided voters across 3 issue dimensions