The Impact of Voting Advice Applications on Vote Choice, and Issue Congruence

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Abstract

Prominent theories of voting assume that citizens vote for parties and candidates that are ideologically close to them. Generally speaking, substantive representation is better achieved if politicians are ideologically mirroring voters that elect them. However, voters do not necessarily possess the relevant information to place themselves, parties, and political candidates in the same ideological space. Thus we do not know whether voters who do not align their electoral choice with their ideology do it on purpose or if they do so because they do not have the necessary information to position themselves in the same ideological space as parties and candidates. We contribute to this gap in the literature with two real-world experiments that test how high-quality information on politicians affects the congruence of vote choice during a sub-national and a national electoral campaign in Switzerland. We used the Voting Advice Application Smartvote as a treatment to evaluate how easily readable information on ideological closeness impacts the congruence of vote choice during political campaigns. Our results show that voters who use the VAA significantly decrease the ideological distance between their position and the position of the political parties and candidates they vote for. In doing so, this paper has both theoretical and practical relevance for the well-functioning of representative democracies.

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Introduction

A key feature of democracies is to have well informed citizens. Prominent voting models such as the proximity (Downs, 1957) or the directional (**?**) models of voting consider that voters have the necessary information to measure the distance between their ideological position and the position of parties and political candidates. Even the model of dynamic representation of **?** considers that citizens and politicians always evaluate each-others position and reward or punish incumbents based on these evaluations. More generally, theories of representation rely on voters knowing the position of political parties and deciding for the party or candidate that is closest to them and thus represents their interests best. In sum, electoral institutions in modern democracies expect voters to make voting decision congruent with their position on policies. However, to make such informed decisions is complex, given that the voter needs not only to have a clear idea about his or her own positions on a number of issues as well as what parties and political candidates stand stand for. Yet, research often show that voters have rather low levels of general political knowledge (**?**).

For the working of democracies it is thus crucial that citizens have access to easily available, high-quality information about candidates or parties and their positions. To provide exactly such information is the aim of so-called Voting Advice Applications (VAAs): Based on an online platform, they provide voters with clear, easy-to-understand information on parties' and candidates' position to support their decision making process and facilitate their choice of parties and candidates that represents them well(Lau & Redlawsk, 2006).

Voting Advice Applications (VAAs) have established themselves as important sources of information in elections over the past 20 years. They are used by millions of voters and are also taken seriously by parties and candidates. In this respect, it is not surprising that in recent years a growing number of studies have addressed questions about their influence on voter behaviour - e.g., participation in elections or voting decisions (for an overview, see Munzert, Barberá, Guess, & Yang, 2020; Munzert & Ramirez-Ruiz, 2021).

Yet, important questions remain: We do not know whether voters indeed use the information the VAA provides to choose parties or candidates that are closer to themselves. In other words, do citizens use the information provided by VAAs on policy position to update their vote intention during election campaign and if yes, is the updating in the direction of a closer match between candidates/parties and voter, i.e. improving the congruence of their vote choice? These are important questions that lay at the core of what a VAA is supposed to do.

While the literature has seen an "experimental turn" in recent years (for an overview see Munzert et al., 2020), it is still struggling to provide an answer to this crucial question either due to small or biased samples (e.g. Germann, Gemenis, & Mendez, 2022; Pianzola, Trechsel,

Vassil, Schwerdt, & Alvarez, 2019) or because researchers lack information on the use of VAAs and the activities inside the platform (e.g. Munzert et al., 2020). What we do know is that certain studies at least find an effect of VAA on party switching () or at least on more subtle ways of modified choice such as more parties on the list ().

This paper presents findings of a large-scale pre-registered experiment conducted in Switzerland. In the run-up to the elections in the canton of Bern (regional elections), we conducted two waves panel survey with a pre- and a post-election survey. In between waves, we invited a random sample of participants to use a VAA and recorded their policy positions as well as what they have seen as vote recommendation list. In sum, our design allows us to model the ideology of all survey participants (treatment and control) and candidates with a Bayesian IRT model in the same policy-space. We can thus estimate the causal impact of VAA on vote shifting and vote congruence between the beginning and the end of the political campaign and get at the core question of whether high-quality information in the form of a VAA impacts the vote to make it more congruent.

Our study innovates on several fronts: First, the rigorous experimental design with a large sample of respondents allows to causally investigate the impact of VAA use. Importantly, since we possess detailed information on respondents' answers to a series of policy questions, we get precise estimates of voters' issue positions which are then matched with their vote choices. In sum, this allows us to get at the question of how VAAs influence the distance between voters and candidates and thus to address the broader question how VAAs potentially foster representation and congruence. Our findings indicate that indeed VAA use leads to more vote switches and also increases the congruence between voters' positions and their party choices. These findings have important implications for the democratic potential that VAAs have.

Second, our study speak to the broader literature on how voters reach their decision and what role (high-quality) information plays in there. Our findings indicate in a rigorous yet realistic setting that easy available information can make a difference and thus underlines the importance of the electoral campaign, the media and other actors to provide such high-class information to a broad range of citizens.

Theory and hypotheses

Information and vote choice

We see electoral decision-making as a process where voters collect and process information to ultimately reach a decision whom to vote for. Voters come with pre-dispositions such a party affiliation but update their positions and party choice during the campaign. In fact, the main

aim of campaigns is to provide relevant information on candidates policy stances but also their past performance should they have been in office before. Voters are exposed to this information and use it to potentially update their behavior. In this sense, high-quality information is key to adhere to the ideal of an informed choice. Citizens use several channels to inform themselves and also the quality of the information differs.

VAAs' impact on vote choice

In this paper, we are interested in a specific popular tool for voters in many Western democracies to inform themselves about the policy position of candidates or parties and which of these actors comes closest to one' own positions: Vote Advice Applications. The quality of the information citizens are confronted with in these tools is high as candidates and parties have an interest to take their position-taking serious. It comes as no surprise though that VAA are very popular among voters: in Scandinavian and Western European countries, the reach is often more than 20 percent of voters (Germann & Gemenis, 2019).

Given this large radius, it is important not only from a scientific but also from a practical point of view to examine the question whether VAAs have an impact on the electoral behavior. The literature on the impact of VAA is flourishing (see e.g. Garzia & Marschall, 2019). Munzert and Ramirez-Ruiz (2021) even found enough studies to conduct a first meta-analysis of studies dealing with the effects of VAAs on voting behaviour. After a rigorous multi-stage selection process, they still had 22 studies available for the aggregated analyses. They examined three effects of VAA use: Effects on voter participation, on the level of political knowledge and on the actual voting decision. While only moderate positive effects were found with regard to an increase in political knowledge, extremely strong effects were found both with regard to an increase in voter participation and with regard to the influence on the voting decision.

However, Munzert and Ramirez-Ruiz rightly point out the great heterogeneity of the effect sizes within the studies considered. Especially the earlier studies show very high positive effects. However, these are usually studies with a number of methodological shortcomings: self-selection bias of the samples, limited sample recruitment (e.g. only students) or lack of random assignment of VAA usage. VAA researchers have long been aware that many studies, especially older ones, have methodological flaws (Pianzola, 2014). The most promising way to overcome these problems seems to be experimental research designs, which have become something like the gold standard of VAA research in recent years. In this respect, it is not surprising that the vast majority of recent studies are experimental (e.g. Fivaz, Schwarz, & Ladner, 2020; Mahéo, 2016; Munzert et al., 2020; Pianzola et al., 2019).

If in the meta-analysis by Munzert and Ramirez-Ruiz (2021) only those studies with a

more sophisticated experimental design are taken into account, it becomes apparent that no substantial positive effects of VAA use on voting decisions can be demonstrated. It thus seems that the chosen research design has a decisive influence on whether an effect can be proven or not. However, on the basis of the results of Munzert and Ramirez-Ruiz alone, it cannot be concluded that there are no effects on the voting decision. A series of methodologically carefully prepared and in part also experimental studies that were not taken into account in the meta-analysis (or were not yet available at the time the data were collected) certainly provide indications that voting decisions can be influenced by the use of VAAs.

Fivaz et al. (2020) were able to show in the context of a large quasi-experimental study that in elections in Switzerland VAA users more often exploited the possibilities of the Swiss electoral system and specifically adapted their ballot papers (e.g. through increased preferential voting or they distributed their votes among more parties (vote splitting)). Another study (Germann et al., 2022) was also able to demonstrate effects - but mainly among voters who were basically less interested in politics and still undecided about their party preferences. Pianzola et al. (2019) and Garry, Tilley, Matthews, Mendez, and Wheatley (2019) were also able to demonstrate certain effects. These two studies each used changes in the probabilities of voting for a particular party as a measure of the effect on the voting decision. Garry et al. (2019) examined this using elections in Northern Ireland. They did find some influence there, but only for changes in party preferences within ethno-national blocs. The effects of VAAs were too weak to overcome this line of conflict.

The studies listed here have each measured or operationalised the influence on the electoral decision differently. This poses another challenge, which we will revisit and discuss later in this paper in the methodology section. To foreshadow our decision already here: we went for the cleanest yet most challenging change: the switch from one party to the other.

In summary, previous research has failed to provide clear findings on whether or not VAAs change the voting behaviour of their users. However, most studies tend to show such effects at least to a moderate extent. Therefore, we also assume this and formulate our first hypothesis as follows in a very basic form:

H1: VAA use increases vote switching.

H2a: VAA use increase vote switching for voters with large incongruence in their vote intention.

H2b: VAA use decreases vote switching for voters with high congruence in their vote intention.

VAAs' and the congruence of vote choice

To ensure a well-functioning representative democracy, a high degree of issue congruence between voters and parties/candidates plays a crucial role. The extent to which voters' values and preferences are reflected in the policy positions of elected representatives is a key measure of how well democratic processes are functioning (e.g., Golder & Stramski, 2010). Thus, improving ideological congruence has to be seen as a straightforward way for strengthening the quality of democracies (Dahlberg & Holmberg, 2014; Stecker & Tausendpfund, 2016). Against this background and the fact that, despite a multitude of differences in their operational design, all VAAs are ultimately based on the classic concepts of issue congruence (Garzia & Marschall, 2019) and proximity voting (Downs, 1957), it is rather surprising that there are hardly any empirical studies to date that investigate whether the use of VAAs actually leads to better issue congruence or not.

In their meta-analysis Munzert and Ramirez-Ruiz (2021) found clear evidence that the use of VAAs leads to a better information level about candidates and their positions among voters - a feature that was very early on seen as a key feature of these tools. Already as the first VAAs emerged, Lau and Redlawsk (2006) have argued that these tools provide an unprecedented level of control over the flow of information in a campaign and that it was to be expected that voters would become much better informed about the full range of candidates. They were also aware that there could be potentially countervailing effects (e.g. an information overload or even an oversimplification of political debates/viewpoints by VAAs). Nevertheless, they saw VAAs as instruments that lead to more "correct voting" and thus subsequently higher congruence.

Thus, we argue likewise that this enhanced information levels about the positions of political actors should ultimately also lead to an increase in issue congruence as information about the positions of candidates is a pre-requisite for proximity voting and ultimately a congruent vote choice. Arguably the Achilles heel of spatial voting models are their high requirements in terms of knowledge about political candidates. VAAs and their easy accessible information on exactly these issue positions should thus ease the informational burden and lead to more people being able to chose candidates close to them.

Interestingly, the few theoretical research contributions that deal with VAAs indirectly refer to this argument by criticizing these platforms for limiting democratic processes too much to the matching of interests and preferences and thus neglecting other important aspects of democratic decision-making (Fossen & Anderson, 2014; Fossen & van den Brink, 2015). The only empirical study conducted on this topic finds also evidence that the use of a VAA actually improves the issue congruence of the voting decision (Fivaz et al., 2020). Thus, we formulate the following hypothesis:

H3: Voters who use VAAs have a higher issue congruence than those who do not use VAAs.

Proposed H3: VAA use increases the congruence of vote choice.

Data and method

In this section, we first detail the design of the studies we conducted during the 2022 Bern cantonal election and the study conducted during the 2023 Swiss National election. In a second step, we explain how we used Ordered Bayesian Item-Response theory models to measure the positions of voters and political candidates in a single ideological space and how we use this measure to operationalize the congruence of vote intention and vote choice of respondents in both studies. Finally, we present the measurement models we use to test the hypotheses developed in the previous section.

Study design and data collection

In this section, we first detail the design of the studies we conducted during the 2022 Bern cantonal and 2023 Swiss national elections. In a second step, we explain how we used Ordered Bayesian Item-Response theory models to measure the positions of voters and political candidates in a single ideological space and how we use this measure to operationalize the congruence of vote intention and vote choice of respondents in both studies. Finally, we explain how we identified the treatment group to consider the two-sided non-compliance issue associated with field experiments and present the measurement models we use to test the hypotheses developed in the previous section.

Study design and data collection

We conducted two field experiments during the 2022 sub-national election in Bern and the 2024 Swiss national election. The studies consisted of two wave panel surveys, the first wave at the beginning of the electoral campaign - about six weeks before election days - and the second right after the elections. In between waves, we invited a random sample of respondents to use a Voting Advice application in which voters answer many policy questions and which are used to present them with a ranked list of candidates based on the closeness of their responses to the policy questions. Voters can then mobilize this information to make their voting decision in the following election. This treatment impacts the information environment of voters, giving them a clear view of candidates who are closer to them in terms of policy positions. These designs enable us to estimate whether voters in a highly information environment on the policy position

of candidates change their vote to a more congruent decision during electoral campaigns.

For the first study, during the sub-national election in the canton of Bern, we invited a random sample of 60'000 eligible voters provided by the Statistical Office of the canton of Bern to participate in our study. We conducted the pre-election survey one and a half months before the election and the second wave right after the election, which was held the 22^{nd} of March 2022. A random subset of 75% of the first wave survey respondents was treated between the waves, leaving the remaining 25% as the control group.[1] The treatment was an invitation to use a clone of the VAA *Smartvote* especially designed for this study to save as much information as required about the respondents using it. Respondents received the invitation three to four weeks before the election to use the VAA before casting their vote by postal mail, which they can do up to three weeks before the election.

Overall, 5,723 individuals responded to both survey waves, and of them, 2,510 used also the VAA. We restrict our analyses to respondents who indicated their vote intention in the first wave as well as their vote choice in the second wave for one of the eighth largest party[2]. In addition, we consider only respondents who answered a sufficient number of policy questions to compute reliable estimates of latent policy positions. This case selection leaves 3605 individual respondents, with 980 assigned to the control group and 2625 assigned to the treatment group.

We replicated this research design during the Swiss national election on the 22^{nd} of October 2023. We conducted a two-wave panel survey with a first pre-election wave six weeks before the election and a second post-election wave right after the election. We used 4000 respondents from the Bilendi panel to select respondents for the study. We used quotas on age, gender, and language regions to ensure that respondents represent the Swiss population. In addition, we invited two-thirds of respondents to participate in the VAA between survey waves four weeks before election day.

Overall, 3285 respondents answered the two survey waves. We selected respondents who indicated both their vote intention and vote choice for one of the eight largest parties and who answered a sufficient number of policy questions. This case selection leaves 1687 respondents, with 1087 respondents assigned to the treatment group and 600 assigned to the control group.

Measuring the distance between voters and candidates

The paper tests whether the high information environment on candidates' positions influences voters' decision-making process during the electoral campaign. We hypothesized that voters

[1]The decision to increase the treatment group in size was driven by concerns about potential non-compliance to the treatment and, thus, resulting in power issues.

[2]The complete list of parties we kept for the analyses are: Die Mitte, FDP, SVP, SP, GPS, GLP, EVP and EDU.

should be more likely to switch their vote in a highly informative environment, especially for voters with a low congruence of vote intention. In addition, we hypothesized that a high information environment should decrease the ideological distance between the voters' position and the position of the party they vote for. Thus, one key concept to operationalize to test these hypotheses is the congruence of vote intention and vote choice. This vote congruence relates to the ideological distance between voters and the party or candidate they vote for. In this section, we explain how we designed the study to model the position of party and voters in the same ideological space and how we used these measures to operationalize the congruence of vote intention vote choice of voters.

To measure the congruence of vote intention and vote choice of respondents, we first need to position voters and political parties and candidates on the same ideological space. To do so, we first rely on the VAA data. This data contains responses to the same policy questions of voters and political candidates. For the sub-national election in the canton of Bern, there are 57 questions, and 60 for the Swiss election, all measured on a four-point scale[3]. Using the responses to the VAA questions from survey respondents in the treatment group and political candidates, we can position them all in a single ideological space using an ordered Bayesian IRT model. However, respondents in the control group did not answer the same policy questions as they did not participate in the VAA. To position them in the same ideological space as respondents from the treatment group and political candidates, we asked a sample of seven - for the Bern election - or six - for the Swiss election - policy questions from the VAA to voters from the control group. Using these limited number of questions makes it possible to measure the ideological positions of respondents with high accuracy, as shown in a recent paper by (**?**). These questions were chosen to cover a large variety of topics, to avoid measuring issue specific positions, and based on their discrimination among the political elites. This way we ensure that questions are informative on the latent ideological position of the control group's respondents. In doing so, using ordered Bayesian Item-Response Theory models, it was possible to measure the position of all survey respondents and political candidates who answered the VAAs in the sub-national and national elections. Overall, the models contained the responses to the policy questions from all survey respondents and the responses from all the political candidates who took part in the VAA. For the Bern election, this represented 1905 candidates out of 2214, and for the Swiss national election, this represented 4999 out of 5925 candidates. The ordered Bayesian IRT model can be formulated as follows:

[3]There are additional questions measured on a seven-point scale that were not considered for the measurement of the ideological space

$$Pr(Y_{ij} = k|\theta_j, \beta_i, \alpha_i) = \phi(\theta_j\beta_i - \alpha_{i,k-1}) - \phi(\theta_j\beta_i - \alpha_{i,k}) \quad (1)$$

Where Y_{ij} is the response of respondent j to question i, ϕ is the cumulative normal distribution. β_i is the discrimination of the questions and $\alpha_{i,k}$ is the difficulty of question i for the category k which is ordered so that $\alpha_{i,k} > \alpha_{i,k-1}$. Finally, θ_j is the parameter of interest for the present study as it stands for the ability parameters of respondents j, representing the ideological position of respondents in the model. We ran this model once for the respondents and political candidates in the Bern study and once for the Swiss study. Afterward, we extracted the median of the posterior estimates θ for each respondent j to position the voters in the treatment and control group and the political candidates in the same latent space in the Swiss and Bern. Figure 1 plots the density of positions for respondents in the treatment and the control groups as well as the position of political candidates for the Bern and the Swiss study.

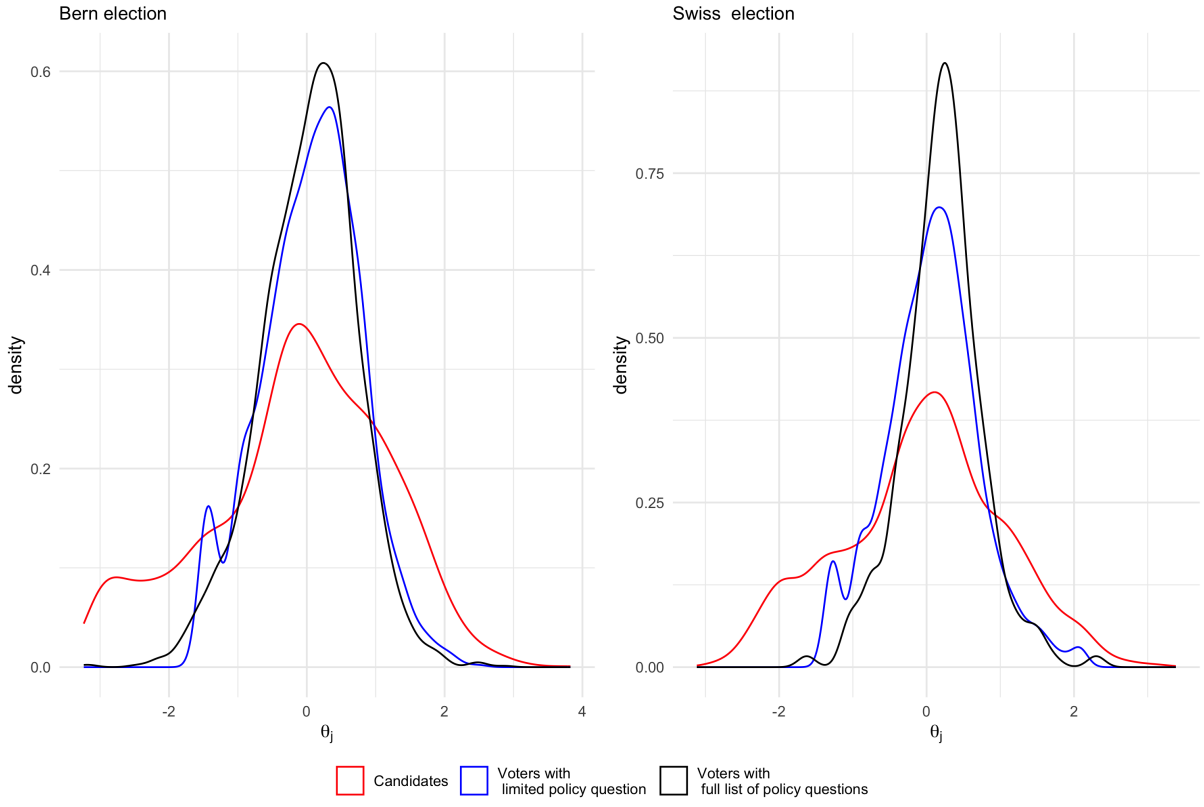

Figure 1: Density distribution of ideological positions voters with the full list of policy questions, voters with limited list of policy questions and political candidates, in the Swiss and Bern election studies.

Figure 1 presents the distribution of ideological positions for respondents in the treatment and the control group and the position for political candidates. The results show that the respondents' ideological position follows a similar distribution for respondents in the treatment and the control group, both for the Bern and the Swiss elections. In addition, we see that

the candidates' position is less concentrated on the center of the ideological space than the position of voters in both elections. As emphasized by (**?**), this indicates that the models with limited and full lists of questions provide similar posterior estimates of ideological positions and indicates that we have reliable estimates of position in the same ideological position than political candidates both for the treatment and the control group. In addition, the similar distribution of ideological position between voters with the full and limited list of questions indicates that there is a equilibrium in ideological positions between the treatment and the control groups.

Having computed the ideological positions of voters and political candidates within the same space, we can now operationalize the congruence of vote choice and vote intention for survey respondents. In this process, we first aggregate the candidates' positions at the party-district levels, as voters primarily vote for candidates through party lists in specific electoral districts[4]. Thus, to account for the variations in the positions of party candidates across districts, we first compute the position of parties in each district as the average position of a party in that district. We then measure all possible ideological distance between each respondent and each party they could vote for using the following formula:

$$DistVote_{ip} = abs(VoterPos_i - PartyPos_p) \tag{2}$$

Where $DistVote_{ip}$ is the distance between the voter's i ideological position and the ideological position of the party p they vote for, which is equal to the absolute value of the difference between the position of voter i - written $VoterPos_i$ - and the position of party p - written $PartyPos_p$. We then standardize this measure so that each respondent's minimal possible vote congruence value is equal to 0. We do so by subtracting the minimal possible ideological distance between each respondent and the parties they could vote for from the ideological distance. Indeed, while some respondents may have the same position as a party and thus have a possible vote congruence close to 0, others may be between parties or positioned to the pole of the ideological axis. As a result, although they would vote for the party closest to their position, they would remain with a high vote congruence. To avoid the variation in the measurement of the congruence of vote choice and vote intention for respondents with different positions in the latent ideological space, we standardize the vote congruence variable by subtracting the minimal value of the congruence of voters for party $Congr_{ip}$. This way, we ensure that if respondents vote for the party the closest to their position, it takes the value 0 and takes a higher value if they vote for another party. Finally, we multiply the measure by -1 to relate more to the concept of congruence. This

[4]In our survey, we asked respondents for which party they primarily vote for. Many Swiss voters directly vote for party lists, but some choose to fill empty lists with candidates' names. Our operationalization enables us to capture the ideological closeness between the voters and the party they mainly vote for.

means that the highest value for the indicator of vote congruence is 0, which means that voters vote for the party closest to their ideological position. Values inferior to 0 mean that voters select parties that are not the closest to their position, and an increase in vote congruence is associated with a lower ideological distance between the voters' position and the party they vote for.

Using our operationalization strategy, we compute three key indicators for each respondent: the congruence of vote intention, the congruence of vote choice, and the difference in vote congruence. The difference in vote congruence is calculated as the disparity between the vote choice and vote intention congruence of voters. To compute these indicators, we require respondents to indicate both their vote intention and their vote choice for one of the ten main parties. However, 'don't know' answers, missing values, or indications of any other party for either variable prevents us from measuring the difference in vote congruence. Consequently, the number of observations for which we can compute the actual difference in vote congruence is lower than the total number of observations in the two wave panel surveys. For the Swiss election study, out of 3285 observations, we can compute the difference in vote congruence for 1685 of them. For the Bern election study, we could compute the position of 3605 respondents out of 5723.

0.1 Treatment allocation and identification

The experiment used in this paper is a field experiment in which we invited a random sample of respondents to use a VAA, which provides them with a highly informative environment on candidates' policy positions. Within the survey, we invited respondents to use VAA software that they can use during the political campaign outside the experiment. Thus, in addition to the treatment allocation and treatment compliance, we are faced with the issue of non-compliance in the control group. This two-sided non-compliance (**?**) makes it challenging to measure the causal effect of our treatment. To know whether respondents were subjected or not to the treatment, we asked them in the post-electoral survey whether they used a VAA. This survey question enables us to identify respondents in the control group who did use the VAA - the non-compliers of the control group. However, in doing so, we also see another challenge emerging within the treatment group. Indeed, on the one hand, some respondents complied with the treatment but did not report using the VAA, and on the other hand, some respondents did not use the treatment but did indicate using the VAA. As a result, it is difficult to know exactly which respondent to consider in the treatment and the control group in our analyses and how to estimate the causal effect of the treatment.

To overcome this issue, we suggest several operationalizations of the treatment and the control group. First, we consider a minimal treatment and control group. This identification

Treatment type	Conditions		Number of observations	
	Treatment	Control	N Swiss study	N Bern study
Treatment min.	In treatment group, took the treatment & indicated using the VAA	In control group & indicated not using the VAA	168(T)+488(C) = 656	1091(T)+821(C) = 1912
Treatment all	In treatment group & took the treatment	In control group & indicated not using the VAA	216(T)+488(C) = 704	1643(T)+821(C) = 2464
Observed use	In treatment group & took the treatment, or indicated using the VAA	Did not use the treatment & indicated not using the VAA	614(T)+1059(C) = 1673	1947(T)+1641(C) = 3598
Assigned	In treatment group	In control group	1087(T)+600(C) = 1687	2625(T)+980(C) = 3605

Table 1: Caption

considers only respondents who complied with the treatment or the control and indicated using and not using the VAA respectively in the post-electoral survey. Second, we propose a maximal treatment and control group. This identification compares the compliers of both groups, ignoring the treatment compliers who indicated not using the VAA in the post-electoral survey wave. Third, we consider the observed use and non-use of VAA, which compares treatment compilers and respondents who indicated using the VAA in the post-survey wave as the "treated" and respondents who indicated not using the VAA in the control group. Finally, relying on the Complier Average Causal Effect developed by **?**, we also used the treatment assignment in the first stage of a two-stage least square regression model. Overall, we analyze the effect of VAA use on vote switching and vote congruence with three different operationalizations of the treatment and the control group. We present results for each of these groups in the result section. In addition, we also use the treatment allocation as an instrument in a two-stage least square model, which we discuss in the next section. Table 1 summarizes the different treatment and control groups as well as the treatment assignment.

As shown in Table 1, the number of observations considered for the different treatment and control groups varies significantly. For the Swiss election study, the number of observations grows from 656 with minimal treatment identification to 1641 with the observed use of VAA. For the Bern election study, it ranges from 1912 respondents with the minimal treatment to 3598 with the observed use. Finally, we see that for the treatment allocation, we have a slight increase in the number of observations we could consider in both studies, which represents the respondents who did not answer the survey question on the use of VAA. While these groups present different identification logic, our analyses aim to observe whether the use of VAA with different treatment specifications has some impact on the probability of switching votes and on

the congruence of voting decisions. Thus, combining analyses with the different specifications enables us to test more strictly our related hypotheses.

Measurement models

We now turn to the measurement model strategy for the analyses. The analyses are presented in three parts. First, we investigate the relationship between the usage of the VAA and the probability of switching votes (H1). Second, we present the moderation effect between the treatment and the congruence of vote intention on the probability of switching votes between the pre and post-electoral survey waves (H2a & H2b). Finally, we estimate the effect of the treatment on the difference in vote congruence between the congruence of vote choice and the congruence of vote intention (H3).

Overall, we test our hypotheses with four regression models for treatment identification strategy presented in Table 1 and each study. The first includes only the treatment as an independent variable, the second includes the congruence of vote intention as a control variable, and the third includes two other control variables that influence the probability that respondents take the treatment. As shown in **?**, political interest and VAA awareness are strong drivers of VAA use. As a result, we control for the interest in voters' politics, a variable differentiating four political interest levels. Second, we add a binary variable indicating whether respondents were aware of the existence of VAA or not.

The fourth and final model is a two-stage least square regression that estimates the Complier Average Causal Effect (CACE) under the two-sided noncompliance condition. As proved with the CACE theorem of the two-sided noncompliance by **?**, the CACE can be estimated with a two-stage least square regression, with the first stage being the effect of the treatment assignment on the probability to be treated. Thus, for this fourth modeling strategy, we consider the treatment allocation as the instrumental variable and the "observed use" as defined in Table 1 as the independent variable. This modeling strategy aims at estimating the causal effect of our treatment. However, as shown in Table 1, a large number of respondents used the treatment outside of the treatment group, which may lower the CACE. In addition, many treatment group respondents used the VAA by their own means. According to the CACE, they are considered as compliers to the treatment but are not part of the minimal or maximal treatment groups. Finally, as emphasized by **?**, the use of VAA and compliance with the treatment is influenced by individual political predispositions. These variations from our design make it difficult to estimate the causal effect of the treatment, even while estimating the CACE. We nevertheless are confident that the cumulation of the models and identification of the treatment can give reliable results on the effect of the highly informative environment of the VAA on the vote

switching and vote congruence of voters.

In the next section, we present the results of this study. Overall, we run twelve linear regressions for each study to test each of the hypotheses. For the moderating hypotheses (H2a & H2b), we present the interaction effect in a figure based on the results of the models that include all the controls. In the end, we discuss the causality of the results, especially in the Swiss national election study where, as shown in Table **??**, the congruence of vote intention has a sizable effect on compliance with the treatment and the use of VAA. Finally, we discuss our main findings and roads for future research in a conclusion.

Results

This section presents the results of the analyses in three parts, which are related to the different hypotheses. First, we present the treatment's effect on vote switching during the political campaign. Second, we present the conditional effet between the treatment and the congruence of vote intention on vote switching. Finally, we present the results for the analyses of the treatment's effect on the difference between the congruence of vote choice and vote intention.

We present results for the Swiss and the Bern election study in each section. In addition, we present the results of four different models related to the different operationalization of the treatment and the result of the two stage least square regressions. Finally, for each model evaluating the direct treatment effect - to test H1 or H3 - we present results with a different set of controls as stipulated in the prevous section.

0.2 Effect of high information environment on vote switching

The first expectation of this paper is that using the VAA increases the probability of switching votes. Indeed, we argue that voters are more likely to notice parties closer to them with the full information presented in the VAA than with the information they otherswise have during the political campaign. Figure 2 presents the regression coeficient as well as the 95% confidence interval of the treatment on the probability to switch votes in the different settings.

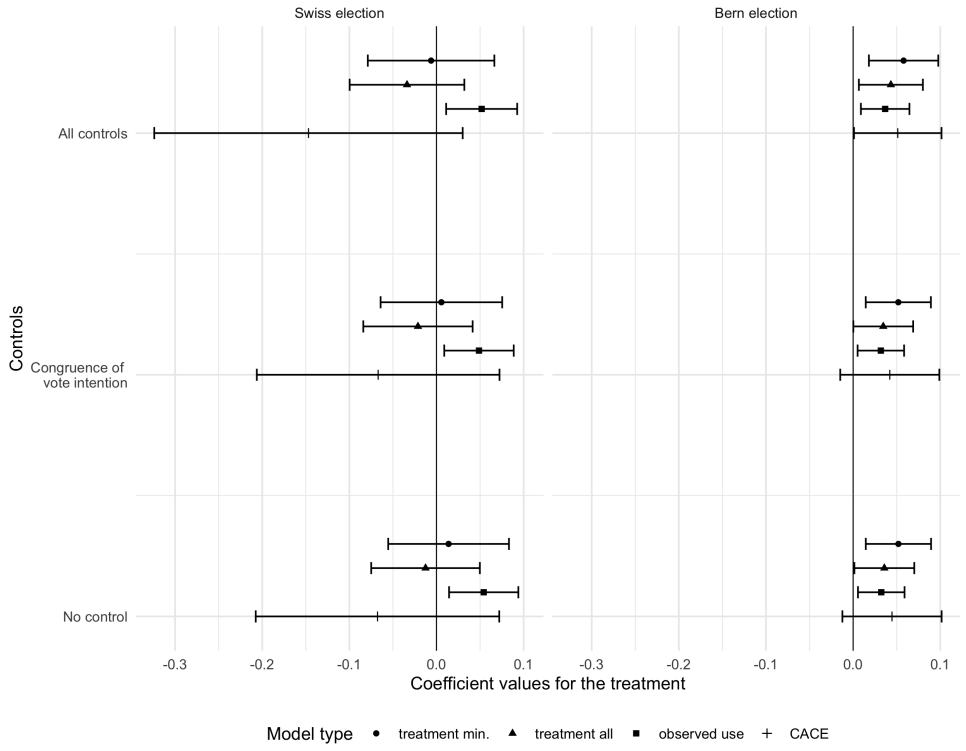

Figure 2: Caption

Figure 2 first shows that while we do not see a consistent effect of the treatment on vote switching in the Swiss election study, the Bern election study yields consistent positive treatment effects throughout the different model specifications. Yet, in the Swiss election study, we see that the observed use of VAA also yields positive and significant impact of the treatment. This result confirms that using the VAA increases the probability of switching votes during the electoral campaign. However, the difference of results consistency between the Bern and the Swiss election study makes it difficult to yield any definitive conclusion.

One key aspect of the Swiss election study is its national scale. This means that the use of VAA in the wild is more widespread than during the Bern election study, potentially introducing a bias in VAA use. In our case, if voters with higher vote congruence are more likely to comply with the treatment, this could drive the treatment effect. Although we present models that control for the congruence of vote intention, as emphasized in hypotheses 2a and 2b, there may be a conditional effect between the treatment and the congruence of vote intention. If treatment compilers have higher vote congruence, they may be less likely to switch votes as the VAA use confirms their vote intention. However, we still observe a positive and significant effect of VAA use, suggesting that when considering all 'treated' respondents, there is an increased probability of vote switching. This means that overall, VAA usage increases the probability of vote switching. Yet, in the Swiss election, we do not observe this effect within our treatment group but more within the entire population who used the treatment.

0.3 Conditional effect of high information environment and congruence of vote intention on vote switching

This section presents the conditional effect between the treatment and the congruence of vote intention. We hypothesized that using VAA should increase the probability of switching votes during the electoral campaign for voters with low congruence of vote intention and decrease this probability for voters with high vote congruence. As a result, we consider that the treatment moderates the effect of the potential improvement of vote congruence on the probability to switch votes.

Figure 3 presents the conditional effect between the treatment and the congruence of vote intention for eight different models. The analyses show that the conditional treatment effect is stronger in the Swiss election study than in the Bern election study. Indeed, the difference between the slopes of the treatment and control groups is higher for the Swiss election study than for the Bern election study. However, we see that with all model specifications, the relationship between the congruence of vote intention and the probability of switching votes for the treatment and the control and the treatment group always goes in the right direction. Indeed, we observe

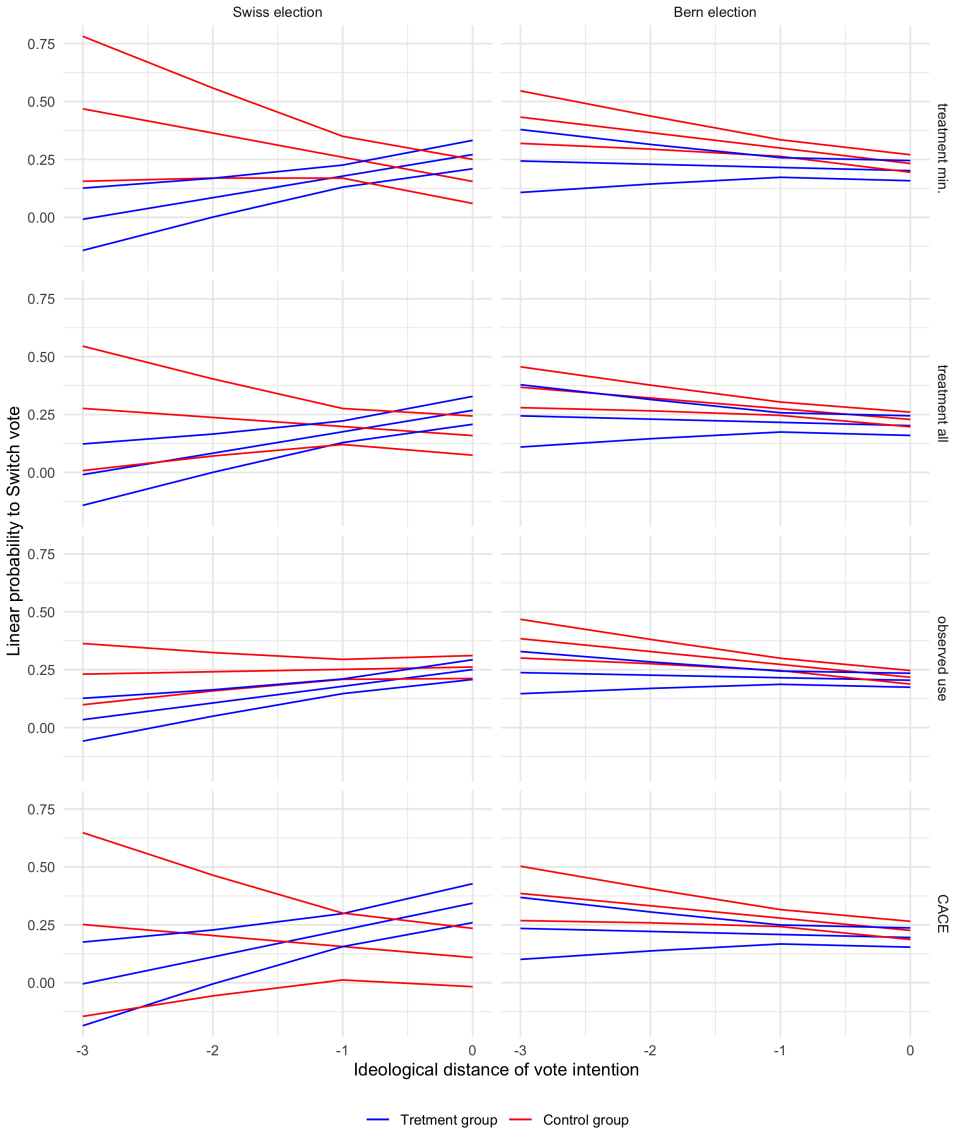

Figure 3: Caption

that the probability of switching votes is higher for respondents with low congruence of vote intention who used the VAA than the control group compared the difference between these groups for high congruence of vote intention.

One interesting phenomenon is that the effect is weaker for models in which there was a strong direct treatment effect. Indeed, we see that the conditional effect goes in the expected direction for the Bern election study but is weaker than for the Swiss election study. In addition, we see the difference in the probability of switching votes between voters with low vote congruence in the control and the treatment group is lower for the model with the observed VAA use than for the other model specifications. These results suggest that the treatment impacts the probability of switching votes, either directly or moderated by the congruence of vote intention.

Our analyses suggest that using a VAA during an election campaign significantly impacts the decision-making process of voters. The VAA creates a high-information environment that alters the probability to switch vote, thereby influencing the relationship between the congruence of vote intention and the probability to switch vote. These implications are not only intriguing but also hold potential for further research and practical application.

0.4 Effect of high information environment on the difference of vote congruence.

The last inquiry of the paper is to estimate whether the change in voting decisions leads to a more congruent voting decision. In other words, we investigate whether using the tool leads voters to vote for a party closer to their position and, in the end, elect more congruent party candidates than they would have otherwise. Indeed, we show that using the VAA impacts vote-switching during electoral campaigns. However, it is unclear whether voters change their vote for a party that is more in line with their ideological position. In this section, we test this assumption by analyzing the effect of the treatment on the difference in the congruence of vote choice and vote intention. Figure 4 presents the treatment effect on the difference in congruence between the vote intention and the vote choice of respondents.

Figure 4 shows a systematic positive effect of the treatment on the difference in vote congruence. The results indicate that voters who used the VAA increased the congruence of their vote choice during the electoral campaign more than voters who did not use the VAA. This result holds for both the Swiss election study and the Bern election study. Indeed, we see that with the 24 different model specifications, the treatment effect has a positive regression coefficient.

Considering the Bern election, it is clear that the treatment affects the vote switching during the political campaign towards more congruent parties. The first part of the analysis shows a causal effect of the invitation to the VAA on the probability of switching votes, and the second

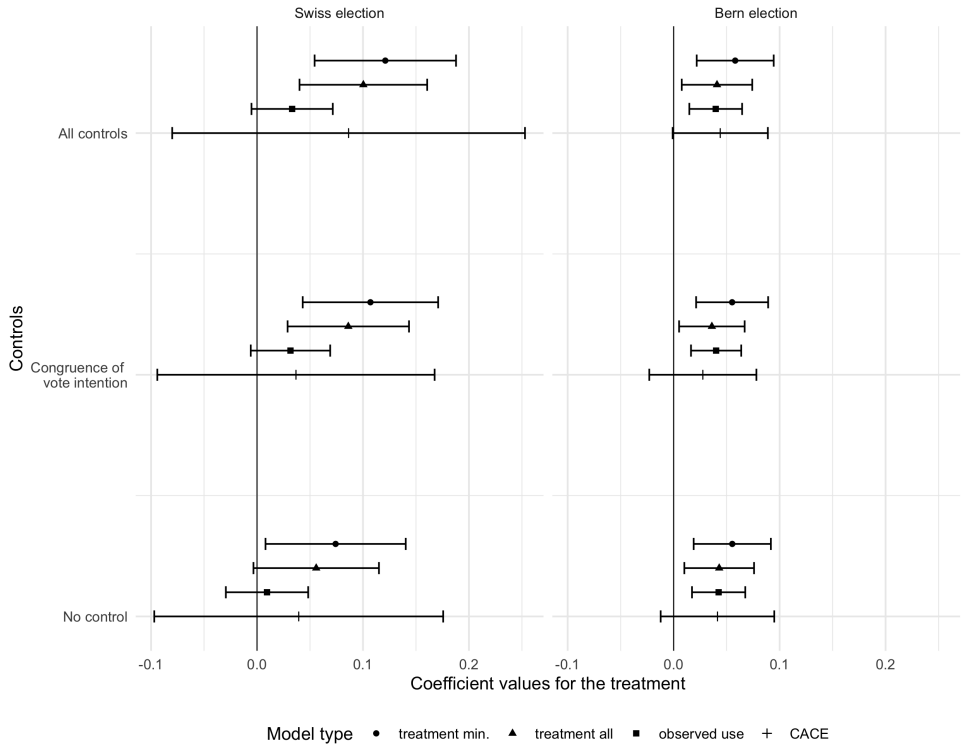

Figure 4: Caption

part of the analysis shows that this increased vote switching leads to higher vote congruence in voters' electoral decision-making. However, the results of the Swiss election are less clear. Indeed, while we first see no consistent effects of the treatment on the probability of switching votes, we still observe that VAA use, in general, increases the probability of switching votes. Second, while we find systematic evidence that the treatment and, more generally, using the VAA increase the congruence of vote choice, this result is not significant in all the different specifications, especially not when looking at the CACE with the two-stage least square models.

The results in these two electoral contexts differ relative to one another. Our results clearly show that using the VAA increases the congruence of vote choice. However, why do these contexts vary so much? The difference lies in using VAA in national and sub-national elections. Indeed, first, while we observe a slight increase in the number of users in the election of Bern between the treatment group and the observed use - about 18% more users - in the Swiss context, we see close to a 200% increase in the number of users when looking at the observed use. As a result, the causal effect of the invitation to use the treatment is more subjected to the selectivity bias of VAA use. Also, the randomization checks presented in Table 2 and Table 3 in the appendix show that while treatment compliance is not affected by the congruence of vote intention for the Bern election, it has a significant positive effect in the Swiss election. This effect means that respondents with higher congruence of vote intention were more likely

to use the VAA or comply to the treatment. As emphasized throughout the paper, the effect of VAA is expected to be stronger for voters with low congruence of vote intention as the potential for improvement is higher. However, voters can use other information during the campaign to increase the congruence of their vote choice. Despite this, we still find evidence that the usage of VAA increases the probability of vote switching and the congruence of vote choice during the national electoral campaign. Our experiments yield clear results about the effect of a highly informative environment on the vote choice of citizens.

Conclusion

In this paper we present the first preliminary results of a large-scale survey experiment conducted on the occasion of the elections in the canton of Bern in March 2022. Even though our study was conducted in the context of a regional election, we consider our findings generally relevant for the discussion about the impact of VAAs on voter behaviour as well as on the quality of democratic processes – not at least due to the rigid experimental research design and the large sample seize of our study.

We found evidence that the use of VAAs impacts both the voting decision and issue congruence. It is thus not only making citizens update their party preference but also in a way that is consistent with a better match.

By relying on vote switching as the measure to analyze the impact of VAA use on vote choice we follow a rather restrictive and conservative approach. It is therefore not surprising that we could observe only minor effects on the voting decisions. For 77% of the study participants, there was no change between the voting intention and the actual voting decision. Walgrave, Van Aelst, and Nuytemans (2008) were already able to show that only about half of the VAA users adjusted their voting decisions. The Swiss open-list electoral system, however, allows voters to change their preferences in a more diverse and subtle way. For example, using data from Switzerland and a similar study design to this study, Fivaz et al. (2020) were able to show that the use of a VAA resulted in ballot papers being more often adjusted (votes were distributed among more parties and more preference votes were given to specific candidates). Pianzola et al. (2019) can also show that the use of a VAA in elections in Switzerland led to more parties being considered eligible.

With a view to further developing the analyses initiated in this paper, it would make sense to consider not only the strict measure of (complete) vote switching but also to include lower-threshold measures such as the number of parties receiving votes from a voter or the composition of the ballot paper. From this not only the evaluation of effects on vote choice would benefit

from more detailed and nuanced measures, but it would also enable a more precise measurement of other aspects as issue congruence or political polarisation. If for example, a voter still gave a majority of the votes to an extreme party, but due to using a VAA a couple of votes to a more moderate party, this would lead to a decrease of polarisation. However, with restricting our measure on complete vote switching, we are not able to record such an impact. Thus for future analyses of VAA effects in open-list electoral systems a combination of the measures applied in this paper as well as in Fivaz et al. (2020) would be welcome.

While there is already a large number of studies looking at the effects of VAA use on electoral behaviour, this study represents one of the first attempts to measure VAA impacts on more "downstream" aspects, which are affected by the impact on vote choice indirectly as issue congruence and the degree of political polarisation. This is somewhat surprising and regrettable, because in terms of the discussion on the quality of democratic processes, these two aspects clearly have a greater significance than the question of the actual electoral decision. Lesschaeve and Padmos (2021) found evidence that points to the potential value of VAAs as mechanisms to strengthen democratic representation and accountability. Whether VAAs are really able to do this and not only have the theoretical potential to do so should be studied more broadly in future empirical studies.

Finally, it would be welcome, if the research design chosen in this study would be replicated in different contexts as closed-list electoral systems or majoritarian electoral systems.

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Appendix

Table 2: Regression results on the treatment compliance and allocation (CH)

	Observed use	Treatment min	Treatment all	Assignment
Gender	−0.046	−0.017	−0.028	0.030
	(0.025)	(0.038)	(0.039)	(0.026)
Congruence Vote intention	0.068***	0.089**	0.085**	0.023
	(0.019)	(0.029)	(0.029)	(0.019)
Left-right	−0.004	−0.002	0.002	0.008
	(0.005)	(0.007)	(0.007)	(0.005)
Political interest (ref: Very interested)				
Rather not interested	−0.264***	−0.067	−0.051	0.034
	(0.038)	(0.056)	(0.058)	(0.039)
Rather interested	−0.125***	−0.090*	−0.059	0.012
	(0.028)	(0.042)	(0.043)	(0.029)
Not interested	−0.283***	−0.070	−0.035	0.055
	(0.076)	(0.120)	(0.121)	(0.076)
Age (ref: 18-24				
25-34	−0.035	0.022	0.048	0.042
	(0.045)	(0.073)	(0.076)	(0.046)
35-44	−0.099*	0.080	0.105	0.062
	(0.044)	(0.070)	(0.073)	(0.045)
45-54	−0.174***	0.121	0.144*	0.041
	(0.044)	(0.068)	(0.071)	(0.045)
55-64	−0.226***	0.020	0.073	0.031
	(0.044)	(0.068)	(0.071)	(0.044)
65+	−0.373*	−0.170	−0.174	−0.433**
	(0.146)	(0.150)	(0.158)	(0.149)
Constant	0.714***	0.319***	0.287***	0.544***
	(0.050)	(0.077)	(0.080)	(0.051)
Observations	1,586	584	611	1,612
R^2	0.076	0.046		
Adjusted R^2	0.070	0.028	0.021	0.004
Note:				*p<0.05; **p<0.01; ***p<0.001

Table 3: Regression results on the treatment compliance and allocation (BE)

	Observed use	Treatment min	Treatment all	Assignment
Gender	−0.009	0.005	−0.004	0.004
	(0.015)	(0.020)	(0.017)	(0.013)
Congruence vote intention	−0.009	0.006	−0.016	−0.013
	(0.013)	(0.018)	(0.015)	(0.011)
left-right	0.026***	0.032***	0.025***	0.009*
	(0.004)	(0.006)	(0.005)	(0.004)
Political interest (ref: Very interested)				
Rather not interested	−0.052	0.004	−0.041	0.010
	(0.085)	(0.107)	(0.091)	(0.076)
Rather interested	−0.088	−0.031	−0.067	0.006
	(0.085)	(0.108)	(0.092)	(0.077)
Very interested	−0.039	0.001	−0.040	0.009
	(0.086)	(0.109)	(0.093)	(0.077)
Age (ref: 18-24				
25-34	−0.048	−0.029	−0.019	−0.021
	(0.039)	(0.051)	(0.047)	(0.035)
35-44	−0.019	0.033	0.032	0.043
	(0.039)	(0.050)	(0.046)	(0.035)
45-54	−0.078*	−0.086	−0.036	0.005
	(0.037)	(0.049)	(0.045)	(0.033)
55-64	−0.149***	−0.122*	−0.048	0.033
	(0.036)	(0.049)	(0.044)	(0.033)
65+	−0.197***	−0.239***	−0.094*	0.008
	(0.035)	(0.047)	(0.043)	(0.032)
Constant	0.476***	0.386**	0.509***	0.609***
	(0.090)	(0.118)	(0.100)	(0.081)
Observations	4,686	2,475	3,183	4,707
R^2	0.026	0.048	0.015	0.003
Adjusted R^2	0.024	0.044	0.012	0.001
Note:	*p<0.05; **p<0.01; ***p<0.001			