Proximity and directional theory compared:  
Taking discriminant positions seriously in multi-party systems  

Zoltán Fazekas*  
University of Vienna  
Austria  

Zsombor Z. Méder†  
Maastricht University  
The Netherlands  


Abstract  
This paper tackles the problem of comparison between proximity and directional voting in 27 European multi-party systems. This is a previously unaddressed aspect of European spatial issue voting. We focus on the spatial voting theories as predictors of vote intention, evaluating the extent of proximity and directional voting. We describe the influence of identical predictions on the comparison of these theories. Our multilevel analysis of the 2009 European Election Study data shows more empirical support for proximity voting than directional voting in the countries analyzed. It does this by clearly differentiating between those cases where it is possible to compare proximity and directional voting and where this is impossible. Nevertheless, the prevalence of proximity theory decreases in more polarized party-systems.  

Keywords: proximity voting, directional voting, discriminant predictions, cross-country comparison.

*Corresponding author: zoltan.fazekas@univie.ac.at. Address: Department of Methods in the Social Sciences, Rooseveltplatz 2/4, Office 414, 1090 Vienna, Austria. Phone: +43-1-4277-49913. Fax: +43-1-4277-9499.  
†z.meder@maastrichtuniversity.nl. Address: Department of Economics, P.O.Box 616, 6200 MD, Maastricht, The Netherlands.
1 Introduction

Spatial issue voting occupies an important place among theories of vote choice and candidate preferences (Downs, 1957; Enelow and Hinich, 1984; Rabinowitz and Macdonald, 1989; Westholm, 1997). Previous research frequently discusses and compares the proximity and directional theories of voting. This comparison perplexes researchers because these theories have very different implications for evaluating voter preferences and party competition (MacDonald et al., 1998; MacDonald and Rabinowitz, 2001; Lewis and King, 1999; Westholm, 1997, 2001). proximity voting suggests that the preferred party will be the most similar one to the voter in terms of preferences. The voter gains maximum utility if she chooses a party that has exactly the same issue or policy position as she does (Downs, 1957; Enelow and Hinich, 1984). On the contrary, the directional rule posits that individuals first choose a side such as pro or against an issue, or left vs. right and their utility is maximized by the party being most intense about that particular side of the issue. Essentially, given the preferred side, the most extreme party should be the voters first choice (Rabinowitz and Macdonald, 1989). On one hand, individuals can be more responsive to moderate policy stances that are close to them; on the other hand they might reward extreme policy stances. This in itself also constrains the possible choices of parties and candidates: knowing whether votes can be maximized by moderate or extreme positions shapes their policy stances and campaign message (Adams and Merrill, 1999; Bernstein, 1995; Downs, 1957; Rabinowitz and Macdonald, 1989).

However, comparing proximity and directional theory is a complicated task (Lewis and King, 1999). Methodological problems not withstanding, one major substantive problem is that these theories frequently predict the same first preference (Tomz and Houweling, 2008). In this case, we cannot evaluate which theory fares better, and hence resolve the differences introduced above. More recently, this task became even more problematic, because researchers aim at cross-country comparisons between these two spatial voting theories (Lachat, 2008; Pardos-Prado and Dinas, 2010). Even if proximity theory is a better predictor of party preferences than directional theory, it might well be the case that in different institutional contexts this comparison would change in the favor of directional theory. However, we do not know whether the change in contextual factors changes also the conditions of the comparison between proximity and directional theory. We contribute to the better understanding of these two spatial issue voting theories by discussing the conditions of comparability given voter preferences and party-system constellation. We argue that cross-country research should take into consideration the problem of distinct predictions, and our understanding of the competition between proximity and directional rule should be refined.

In the present paper we offer an analytical framework for comparing these two theories

---

1Cf. papers in the 1997 Special Issue of Journal of Theoretical Politics.
across multi-party systems. First, we flesh out what are the conditions of comparison in multi-party systems and then quantify how much do the comparisons depend on (1) what sort of party and (2) voter positions do we employ in our analysis. Next, we turn our attention to a possible data structure given by the 2009 European Election Studies. We show that if we focus on the first preference, in around 75% of the cases proximity and directional theory offer identical predictions. We then evaluate the role of party positions in the 27 European countries in the comparison. Strikingly, any empirical comparison in these multi-party systems is only a partial one. Proximity theory stipulates that the first preference should be the most proximate party even if this party in on the opposite side of that issue or ideological continuum. This only means that there are no sides on the issue and they should be considered in a purely positional fashion on a continuum (Westholm, 1997). The 2009 party constellation does not offer the empirical possibility to test this implication of proximity theory as there will always be a closer party on the same side of the issue continuum. At this point, our paper points out two serious aspects related to the content of comparison that should inform our comparative analysis. We clarify and explicitly state under which circumstances we can determine infer whether one theory is better than the other.

In our empirical analysis, we test the hypothesis that party-system polarization systematically influences the performance of these two theories, and we explicitly account for the problem of discriminant predictions. Lachat (2008) focuses on the variation of proximity voting across countries and reports that proximity voting gets stronger in countries where there is higher party-system polarization. Furthermore, he notes that this pattern is also found for directional voting. However, Pardos-Prado and Dinas (2010) report that countries with more polarized party-systems enhance the explanatory power of directional theory, but this is not the case for proximity voting. We evaluate these seemingly contradictory findings. We find that the tenets of adversarial party competition in more polarized party-systems gives a slight systemic edge to directional voting, however proximity theory still presents itself as a better captor of first party preferences. The level of party-polarization has to be extremely high in order for directional theory to overtake proximity theory in terms of accurate predictions. But in these regions of the data statistical uncertainty makes it impossible to declare a clear winner. Substantively, our results suggest the prevalence of proximity voting even across different contextual factors.

We proceed by discussing issue voting and the two spatial theories in the next section, introducing our operationalization focused on the accuracy of predictions and presenting the the role and manner of possible comparisons (Section 2). In Section 3 we formulate our contextual hypotheses, while in Section 4 we test them on the 2009 European Election Studies. After presenting the results (Section 4.4), we finish our paper by discussing the implications of these findings (Section 5).
2 Spatial voting in a comparative setting

2.1 Overview and operationalization

Previous research argues that the increased importance of issues in the electoral decision-making process stems from the decline of the importance of social structure and cleavages (Thomassen, 2005; Lachat, 2008). Classical class identity does not sort the electorate accurately any more, and this leads to enhanced emphasis on issue considerations throughout time.\(^2\) Although electoral competition is not necessarily unidimensional, the left-right ideological continuum accurately summarizes and describes the issue positions of the majority of the electorate, making it suitable for spatial voting analysis in a relatively parsimonious fashion (Cox, 1990; Inglehart, 1990). Consequently, comparative analysis of spatial issue voting focuses on the left-right ideological positioning as a “super-issue” (Lachat, 2008; Pardos-Prado and Dinas, 2010), an avenue that we will also adopt in the present paper.

Proximity and directional theory, as two major spatial voting theories\(^3\), both adapt a rational choice perspective, in the sense that preferences over parties are assumed to be representable by a utility function. This function represents voters as possessing a preferred position on an issue space or on a policy option space, and they see the possible programs that parties offer them through those lenses. Parties have expressed positions on the same issue space, and it is assumed that voters have some information about these positions. In their general form, issue voting theories can be expressed for each political issue, and the final expected utility is given by a weighted summation, according to the salience of each issue for the voter.\(^4\) In our case, the two competing theories will be expressed for only one dimension, the general left-right ideological scale.

The utility of voting for a party defined by proximity theory is the following:

\[
u_i(v_i, p_j) = -(v_i - p_j)^2\]

where \(v_i\) is the position of voter \(i\) on the left-right ideological scale, \(u_i\) is his utility and \(p_j\) is the position of party \(j\) in question on the same scale. It is easy to see that the utility

\(^2\)Also, in a multi-party European setting the role of ideology and issue matters even more compared to the US system, because party identification cannot be characterized with the strong psychological and emotional tie that would assure a stable and powerful partisan voting (van der Eijk and Niemoller, 1983; Schmitt, 2009).

\(^3\)We acknowledge variations and other spatial issue voting theories — such as the Grofman (1985) discounting model or the compensatory model by Kedar (2009) — we focus in this paper only on proximity and directional theory. We do this not because they are necessarily superior to other spatial models, but because the debates and comparisons between these two theories shaped mostly the spatial voting literature. From now on, when we refer to spatial voting in general, we mean proximity and directional voting. Our results and conclusions should be taken as such.

\(^4\)We ignore the possibility of “expressive returns” of voting suggested by Brennan and Lomasky (1993)
of each voter reaches its maximum when the positions of the voter $i$ and party $j$ overlap. Furthermore, the neutral position or the middle of the scale has no specific meaning or importance in the proximity logic. If a voter is on the left of the scale, but the most proximate party is on the right, the voter will still prefer that party, disregarding that they are on different sides. In contrast, **directional theory builds** on this differentiation, and utility of the voter is defined as:

$$ u_i(v_i, p_j) = (v_i - n)(p_j - n), $$

with $n$ representing the ideological middle, or the point of neutrality between left and right. As stated above, directional theory uses a two-step rationale (Westholm, 1997, 866). The voter looks at first whether there are parties on the side that she took on the left-right scale (side rule). If there are, she will prefer that party that holds that side with the most intensity (party intensity rule). Thus, the choice for the most extreme party on the same side will generate the highest utility for the voter. Overall, the highest utility is reached when the voter and the party are on the same side of the issue, and they are both most extreme. In general terms, this utility function specification reflects the assumption that individuals have diffuse policy options (Rabinowitz, 1978).

We focus on these two spatial voting specifications because their accuracy was constantly debated and compared (MacDonald et al., 1998; MacDonald and Rabinowitz, 2001; Rabinowitz and Macdonald, 1989; Pierce, 1997; Westholm, 1997, 2001), and also because they offer very different predictions about the ideal party placements for vote maximization (Bernstein, 1995). However, our operationalization and research focus departs from previous analysis.

We analyze these two theories as theories of vote choice - not strictly theories that describe preference sets through a measure of utility (Westholm, 1997), only the prediction of the first choice is important for benchmarking these theories.\(^5\) For each theory, we store the prediction of the first preference (the choice that yields the highest individual utility according to the two distinct functional forms) and match this prediction to the declared vote intention of the individual. Thus, we will have situations where both theories predict the same party as first preference, but this is not reflected by the vote intention of the individual. In this case, there is no spatial — voting of the two types investigated here — going on, or at least voting does not happen according to the two main competing spatial theories.\(^6\) We also have situations where both theories (still) predict the same, and

\(^5\) Also, but the highest value of the vote propensity essentially overlaps with vote choice or intention (van der Eijk et al., 2006)

\(^6\) It should be mentioned that directional theory has a version which incorporates a certain *region of acceptability* to exclude ultra-extreme candidates. However, no operational concept of acceptability has yet been outlined, and we also lack any thorough empirical analysis on the issue on country-wide acceptability of parties, much less so for the individual level. Thus, we exclude any such augmentation of directional theory, since it would be blatantly arbitrary.
this prediction is accordance with the expressed vote intention of the individual. This scenario shows that there is spatial issue voting going on, however, we cannot clearly discern which of the two theories better describes the vote intention. For the direct comparisons, we will focus on cases where the predictions stemming from the two theories are different. If only those cases are taken when spatial voting is detected to be activated, the two theories become mutually exclusive. This highly constrained scenario will give us accurate insight on how these theories perform against each other. Moreover, looking at this match-up in a comparative setting we can identify what contextual circumstances favor systematically one of the theories.

Through this approach we can better model, represent and understand how the prevalence of these spatial voting models depends on individual and contextual factors. This was not an impossible task even using the utility function approach\(^7\), but this meant specifying interaction terms between individual — and/or contextual — variables and the utility functions in a stacked cross-sectional dataset. The number and complexity of interactions was always kept to minimal for reasons of specification and sample size. When employing the present approach, the question of what determines spatial voting is directly translated into the chosen model, spatial voting being the quantity of interest reflected on the left side of the regression equation.

2.2 Comparing proximity and directional voting

Previous research pursued different paths of comparison, but there is no clear verdict on which theory fares better in very different multi-party systems. Three major issues constantly reappear in the comparison of the two theories: (1) what candidate placements are used (Gilljam, 1997a,b; Merrill and Grofman, 1997; Pierce, 1997; Macdonald and Rabinowitz, 1997; MacDonald et al., 1997, 1998; Rabinowitz and Macdonald, 1989; Westholm, 1997, 2001; Pardos-Prado and Dinas, 2010), (2) the explanation of intra- or inter-individual differences (Westholm, 1997, 2001; MacDonald and Rabinowitz, 2001), and (3) the non-discernible predictions, a central issue of our paper. Unsurprisingly, the first two aspects of this debate are not settled. If indeed all the comparisons depend on operationalization and model assumptions (Lewis and King, 1999), answering which theory better describes vote choice is still a daunting task. Non-discernible predictions emerge because in a real life setting directional and proximity theories often do not differ in predictions (Claassen, 2009; Lacy and Paolino, 2010; Lewis and King, 1999; Tomz and Houweling, 2008). Depending on the position of candidates and the voter we can only distinguish between decision-strategies used in few permutations (Tomz and Houweling, 2008).

These methodological difficulties drove researchers to reconsider the goals and methods of assessments of the competing spatial theories. A mixed approach (Merrill and Grofman,\(^7\)Along party-system polarization, Lachat (2008) also accounts for individual interaction effects.)
1997; Morris and Rabinowitz, 1997; Merrill and Grofman, 1999) combined with the collection of experimental data produced a paradigm shift in thinking about these issues (Claassen, 2009; Lacy and Paolino, 2010; Tomz and Houweling, 2008). In their experiment, Lacy and Paolino (2010) manipulate fictional candidate descriptions, and compare, for example, how extreme voters rate moderate candidates with how moderate voters rate the same candidates. Testing three hypotheses (two directional and one proximity), they find an overwhelming support for proximity theory (Lacy and Paolino, 2010). Similarly, Tomz and Houweling (2008) find that proximity voting is the most frequent for the health care issue, but they also report that strong party identifiers and political novices tend to follow more frequently a directional logic. Thus, this stream of research thinks about the frequency of spatial voting theories analyzed in a setting where the supply side is manipulated in a way that it assures that proximity and directional theory predicts different first preferences. When comparing the two theories, we take into consideration this approach and adapt our empirical analysis to these conditions.

In the following subsections, we turn our attention to the problem of identical predictions.

2.3 When is it possible to declare a winner?

Proximity and directional theory do not provide unique predictions for the first party choice of all voters. When we attempt to discriminate between these two spatial voting theories, we thus have to find all party-voter configurations when there is no unique prediction for either theory, in addition to those in which, although there is a unique prediction for both theories, it is identical.

Suppose there are \( n \) parties, and their positions on the left-right axis are denoted by \( p_i \in [0, s] \) with \( i \in \{1, 2, \ldots, n\} \) and \( n > 1 \), the middle of the spectrum being represented by the position \( m = \frac{s}{2} \). The indices can be chosen such that \( 0 \leq p_1 \leq p_2, \ldots, p_{n-1} \leq p_n \leq s \). Denote the position of the voter by \( v \in [0, \ldots, s] \). If this position is the exact ideological middle, i.e. \( v = m \), then directional theory does not provide a prediction for any distribution of parties over the spectrum.

**Condition 1.** \( v \neq m \).

Condition 1 already excludes a substantial share of voters: in our data, 29.4% of voters position themselves in the ideological middle on average.

If Condition 1 holds and \( v < p_1 < p_2 \) or \( v > p_n > p_{n-1} \), then both theories provide a unique, but identical prediction for first party choice. For proximity theory, \( p_1 \), respectively \( p_n \) is clearly the most proximate party. For directional theory, there are two possible cases. If \( v \) is on the same side of the spectrum as \( p_1 \) (\( p_n \)), then clearly this party is the most extreme on the voter’s side. If, however, \( v \) is on the other side of spectrum, then \( v \)
will still choose this party, albeit reluctantly, since the voter will experience negative utility for this choice. Nevertheless, voting for any other party would cause an even higher utility loss, and not voting is not an option. Therefore, if \( v < p_1 < p_2 \) or \( v > p_n > p_{n-1} \), then both theories predict identical first party choice, and we again cannot discriminate between our two theories.

If, however, \( v < p_1 = p_2 \) or \( v > p_n = p_{n-1} \), then neither theory predicts whether \( v \) chooses \( p_1 \) or \( p_2 \) (\( p_n \) or \( p_{n-1} \)), thus spatial voting is inadequate to explain first party choice. Bringing this together with the result of the previous paragraph, we get:

**Condition 2.** \( p_1 \leq v \leq p_n \).

Condition 2 implies that for additional 36\% of voters in our data, it is impossible to discriminate between the two theories. Note that Condition 2 also implies that there is at least one party on the voter’s side of the ideological spectrum.

Proximity theory does not provide a prediction where there are two parties that are equally proximate to the voter.

**Condition 3.** If \( p_i \leq v \leq p_{i+1} \) for some \( i \), then

- \( p_{i-1} < p_i \), if \( i \geq 2 \);
- \( p_{i+1} < p_{i+2} \), if \( i \leq n-2 \);
- \( v - p_i \neq p_{i+1} - v \).

This condition will only be relevant for discrete party scales, as we will see in the next subsection.

From Condition 2, we know that there is at least one party on the side of the voter. According to directional theory, the voter will always choose the most extreme party on his side, thus, the vote will go for \( p_1 \) if \( v < m \). Proximity theory predicts a different vote if another party is more proximate. But if any other party is most proximate, then \( p_2 \) is also more proximate than \( p_1 \). To see this, suppose party \( p_i \), with \( i \neq 1 \), is most proximate. Then

\[
(v-p_i)^2 \leq (v-p_2)^2 \iff 2v(p_2-p_i) \leq (p_2-p_i)(p_2+p_i)
\]

If \( i > 2 \), then, since \( p_2 < p_i \), we get \( v \geq \frac{p_2+p_i}{2} \geq p_2 \), which implies that \( v - p_1 = (v-p_2) + (p_2-p_1) \geq v - p_2 \). If, however, \( i = 2 \), then \( p_2 \) is clearly more proximate than \( v_1 \). Therefore, a necessary condition for discrimination is that \( p_2 \) is more proximate than \( p_1 \), whenever the voter is on the left. A similar condition can be obtained for the right of the spectrum, as well.

**Condition 4.**

- \( \frac{p_1 + p_2}{2} < v \), if \( v < m \)
\[ p_{i-1} + p_i > v, \text{ if } v > m. \]

Obviously, Condition 4 implies Condition 2, so Condition 2 can be omitted. It is easy to see that Conditions 1, 3 and 4 are sufficient as well, since whenever \( v \) is on the left of the spectrum, \( p_1 \) will be chosen by directional theory; but if \( p_2 \) is more proximate than \( p_1 \), then \( p_1 \) is never chosen by proximity theory. We summarize our results in the following theorem

**Theorem 1.** First-party choice of proximity and directional theories can be discriminated for a particular party-voter configuration if and only if this configuration satisfies Conditions 1, 3 and 4.

Conditions 1 and 3 ensure that both theories provide a unique prediction. Condition 4 ensures that the prediction is different. To see whether the side rule or the intensity rule are at work, we only need to check whether the most proximate party \( p_i \) is on the same side of the spectrum as the voter. We have to note, however, that if Condition 4 holds, and there are more than two parties on the voter’s side (i.e. \( p_2 < m \) if \( v < m \) or \( p_{i-1} > m \) if \( v > m \)), then the first party choice would be different even if the most proximate party was on the voter’s side. This indicates that the intensity rule is more forceful, and hints at more possibilities of differentiation between the two theories when not only first-party choice is taken into account.

### 2.4 How can differentiation be facilitated?

In principle, models of spatial voting can be set up in either a discrete or a dense scale.\(^8\) The foundational writings of these theories (Downs, 1957; Rabinowitz and Macdonald, 1989) do not make a definitive choice for either scale. Nevertheless, the interpretation of a model can have implications on the usage of scale, e.g. when an issue position represents a “numerical” policy choice, such as the budgetary spendings on a certain sector, using a dense scale might be natural. In what follows, we will try to map out the space of topological possibilities for spatial voting theories, leaving the issue of model interpretation aside for now.

The two types of agents that spatial theories deal with — parties and voters — can both be placed on a discrete or a dense scale. Note that the choice of scale topology is independent for these: it is very well possible for voters to inhabit a different scale type then parties. Overall, this generates a total of four topological options for spatial voting models and correspondingly for data collection.

\( T1 \) — discrete scale for both parties and voters.

\(^8\) Obviously, in this setting, “density” means merely the possibility of non-integer party or voter placements, e.g. that a party can occupy position 4.801 on the left-right ideological scale. In all real life scenarios, what we call a dense scale will not be dense in exact the mathematical sense.
$T2$ — discrete scale for parties, dense scale for voters.

$T3$ — dense scale for parties, discrete scale for voters.

$T4$ — dense scale for parties and voters alike.

The typical treatment uses $T1$, mostly because data collection is the easiest with such models. Scale type $T2$ is rather rare, but nevertheless a theoretical possibility. One might, for example, think of the policy concerning income taxes: whereas voters can, in principle, consider any positive real number as the “right” rate, parties have to stick to integers for practical purposes. In a number of studies, voter positions are determined using a discrete scale, while party positions can take non-integer values($T3$). Finally, when both voters and parties are placed on a dense scale, we have an instance of $T4$.

The debate on whether party positions should be determined as the average of expert placements or perceived party positions, or as a perceived party position that varies for each individual (Gilljam, 1997a; MacDonald et al., 1998) has only limited implications on scale topology. In practice, however, when party positions are taken as averages, these values are simply placed on the dense scale, and not rounded to an integer value. When, on the other hand, party positions depend on the perception of the individual respondent, the scale used is typically the same as the one for the self-identification, i.e. a discrete scale. This practice makes any direct comparison of the two approaches less forceful, since the choice of scale topology has strong implications on the comparability of spatial voting theories.

The modeler can choose any of the four possible scale topologies that suites his purposes. This choice depends on the interpretation of issue positions, and the methodology of the data collection. Unfortunately, a higher share of discriminating predictions imply more complex questionnaires: larger scale and/or more complex topology. Using a dense rating scale\footnote{also referred to as continuous or graphic rating scale.} for both self- and party placement would maximize discrimination, but is more difficult to implement, and might induce biases in itself. Despite the obvious interconnections between model interpretation, data collection, and theory differentiation, there has been little research into this area.

To quantify the effect of scale topology, we calculated the share of voter-party configurations where 1. both theories give a prediction concerning voter behavior, and 2. the predicted behavior is different. Considering scale topology $T1$, we conducted an exhaustive search of all possible positions of voters and parties. We investigated odd scales with a size of up to 11, and maximum 12 parties. Our method is described in more detail below in the form of a simple algorithm.

1. Fix the size of the scale at $k$, and the number of parties at $n$;
2. generate all possible positions for one voter and all the parties, i.e. a total of \((n+1)^k\) possibilities;

3. for each of these party-voter position configurations, check whether both directional and proximity theory provide a unique prediction for first-party choice;

4. if they both do so, check whether the prediction is different;

5. divide the total number of discriminating positions found by the total number of possibilities.

This method is tantamount to working with a uniform discrete distribution over party and voter positions. Therefore, for \(T2\), \(T3\) and \(T4\), we assumed uniform distribution directly, and conducted a simple Monte Carlo simulation.\(^{10}\) For each combination of topology type, scale size and party numbers, we executed \(10^6\) runs. The share of discriminating scenarios, alongside with our results for \(T1\), are shown in Table 1.\(^{11}\)

<table>
<thead>
<tr>
<th>Number of parties</th>
<th>Topology, scale size</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>5</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>0</td>
<td>3</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>11</td>
<td>14</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>5</td>
<td>17</td>
<td>25</td>
<td>30</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>10</td>
<td>14</td>
<td>23</td>
<td>29</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>5</td>
<td>11</td>
<td>21</td>
<td>28</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>11</td>
<td>17</td>
<td>24</td>
<td>28</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>12</td>
<td>10</td>
<td>15</td>
<td>20</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>0</td>
<td>6</td>
<td>15</td>
<td>23</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>0</td>
<td>1</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>0</td>
<td>1</td>
<td>6</td>
<td>11</td>
</tr>
</tbody>
</table>

The share of discriminating scenarios increases from \(T1\) to \(T4\). Discretization of party positions hurts chances of discrimination more than discretization of the voter’s position. For \(T1\), even with 7 parties and a scale size of 11 options, the share of discriminating

\(^{10}\)Although it would in principle be possible to derive closed formulas for each parameter combination, the precise share of discriminating scenarios are not important, and Monte Carlo simulation gives adequate information on the order of magnitude of the differences.

\(^{11}\)Note that for \(T4\), the scale size is irrelevant.
configurations is below 25%. This has very severe implications on any empirical analysis that aims to discriminate between the two theories of spatial voting using a \( T_1 \)-type topology.\(^{12}\) Switching from \( T_1 \) to \( T_2 \) brings significant improvements, especially if the scale size is big enough. However, even using \( T_2 \), the maximum share of discriminating scenarios lingers around 33%. Only introducing non-integer party placements raises the chances of discrimination to over 50%.

Table 2 shows the average share of intensity rule for each scale topology type. Party numbers or scale size have only minor effects on these ratios, although larger scales do increase the role of the side rule. Unfortunately, the discriminative power of \( T_3 \) and \( T_4 \) rely mostly on the intensity rule, and the side rule plays very little role. This is especially true of \( T_3 \), the scale topology type that our data relies on.

<table>
<thead>
<tr>
<th>Topology</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
</tr>
</thead>
<tbody>
<tr>
<td>94</td>
<td>57</td>
<td>97</td>
<td>89</td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Share of intensity rule within discriminating scenarios, %

2.5 Differentiation in the data

To check the validity of our findings based on uniform distributions, we moved to analyzing discrimination possibilities in our available data. The 2009 European Election Studies provides a discrete scale for identifying voter positions. For party positions, unrounded perceived party positions are available, therefore, we have an instance of \( T_3 \). Obviously, we expect this setup to allow for a larger share of discriminating configurations, mainly due to the fact that facing a tie for proximity voters — i.e. when at least two parties are at the same ideological distance from them — will become a 0-probability event. Moreover, finer-grained party positions can increase the discriminating intervals, but can never decrease them. By comparing the share of discriminated voters when moving from rounded to unrounded averages, we gain in discriminatory power when moving from \( T_1 \) to \( T_3 \) for our data.

For 25 out of the 27 countries, there was an increase in the share of voters whose behavior is discriminated by two theories, when using unrounded mean of perceived party placements instead of rounded ones, whereas in the other two countries the share remained unchanged. Overall, the share of voters of interest when moving from \( T_1 \) to \( T_3 \) moved

\(^{12}\)In \( T_1 \), the share of discriminating configurations does not converge to one as either the number of parties or scale size goes to infinity, just when they both do. Moreover, the number of parties cannot converge much faster than the size of the scale, otherwise, parties would fall on the same spots on the scale, rendering proximity theory impotent for predicting anything for most voters.
from 8.7% to 27.6%, a three-fold increase. This is a major change; therefore, for our empirical analysis in Section 4 we used the unrounded mean of perceived party placements for distributing the parties on the [0, 10] interval.

Despite the fact that topology $T_3$ allows for more comparability than $T_1$, the average share of voters in discriminating positions across countries is still just 27.6%, significantly less than what could be expected from the simulations based on uniform distribution (c.f. Table 1). This hints to the fact that even with more refined data on voter self-placements that could open the possibility for $T_4$, we would gain little in terms of discriminating voter shares. The principal advantage might come from voters placed on the central position of 5, who would presumably move a little left or right from the middle, giving way to a definite prediction for directional theory.

The exact implications for our multivariate analysis are two-fold. Figure 1 displays that most of the discriminant predictions stem from the moderate individual cases, whereas the predictions on the more extreme individual positions tend to converge towards the most extreme party on a given side of the left-right continuum. This is simply due to the fact that as the individual moves towards the extremes of the scale, the most proximate party will become the most extreme one, generating overlapping predictions with directional theory. Whenever trying to decide whether the most proximate (and more moderate) party will be preferred against the most extreme on one of the sides, we essentially want to see how more moderate individuals decide. The relevant comparison of these two theories is, by definition, focused on more moderate individuals.

Moreover, the range of discriminant prediction varies across countries, depending exclusively on the supply side. The most common constellation is that directional and prox-
imity theory offer different predictions for those situated on 3, 4, 5, 6, and 7. This range shrinks to a minimum in Ireland and Estonia; this is due to a small range of party positions and intense crowding of parties around one pivotal position. Conversely, in Italy and Hungary, even for the more extreme individuals (positions 2 and 8) we find different predictions. Alongside the fact that in these systems parties occupy a wider range on the left-right continuum, we also observe that both in Italy and Hungary, there are two parties to the left from 2, assuring different predictions for the two theories. This also holds true for the Hungarian left, with two parties more to the right than 8. On the Italian right, the *The Right (La Destra)* is the most extreme party, but *The People of Freedom party (Popolo della Liberta)* is situated at 7.91, making it the most proximate party for an individual situated on 8.

These aspects contribute to a substantial reduction of sample size, but they also assure that we indeed directly compare these two theories against each other. We discuss the expected effects of contextual variables on the accuracy of spatial voting in general, and on the two theories separately in section 3.

### 2.6 What does this comparison mean?

When we compare the accuracy of proximity and directional theory, we can do only a limited comparison. Directional theory was introduced because its proponents argued that there is a side rule in the preference formation. This made the middle of the policy continuum a meaningful neutral position that separates those who are for or against a policy. In the case of the classical proximity theory, the individual will prefer the candidate or the party that is located closest to her, disregarding whether they are on the same side. This fundamental dissemblance cannot fully be tested on the cross-country data at hand: individuals are asked to place themselves on a discrete, 11-point scale. Thus 4 and 6 are the most moderate positions that already take a side. Except the case of Italy and Malta, in each European multi-party system we always find a party that cumulatively satisfies the following two conditions: *a*) it the most proximate party, and *b*) it is on the same side of the ideological continuum as the individual.

Consequently, in any attempt to confront these two spatial theories we are establishing our verdict overwhelmingly on the intensity rule (Westholm, 1997), not on the side rule. Essentially, the empirical test of directional theory is based on whether the individual is

---

13 Four out of six parties in Ireland between 3.1 and 4.5, and similarly four out of six parties between 4 and 5.3 in Estonia.

14 Alongside the limited range of individual positions that offer discriminant predictions, we also have high number of missing values for the vote intention question.

15 Reviewing previous works and the time points covered by the analyses, it is highly unlikely that this was different in those cases.

16 For the exposition in this section we refer to the left-right position measured on an 11-point scale, ranging from 0 to 10, with 5 as being the middle point.
more responsive to an extreme party position than to a more moderate party position. Thus, we do not have any consecutive empirical test or result that would support or dismiss the hypothesis that people might switch sides if there is a party on the side of the ideological spectrum that is still closer to them than any other party on “their” side of the ideological continuum. As Malta and Italy are exceptions, we will dedicate some extra attention to these countries.

Both in Malta and in Italy, individuals positioned one point to the right from the neutral point (6) are faced with a more proximate choice that is already on the “left” side of the spectrum. In Malta, the National Action (Azzjoni Nazzjonali) is perceived to have a position of 4.73, whereas in Italy, the Union of Christian and Center Democrats (Unione di Centro) is positioned at 4.87. According to proximity theory, these should be the preferred options for an individual positioned 6 on the left-right ideological scale. We observe in both cases that these are relatively small parties: 6.5% of the vote share for UDC in Italy, and 0.6% for the AN in Malta.

Identifying the vote intention of this subset of our sample, we see that the proximity predictions do not appear to be accurate. In Italy, 51 individuals occupy position 6 on the left-right scale and 28 of them answered the vote intention question. From these individuals 14 expressed that they intend to vote with The People of Freedom Party (Popolo della Liberta), the biggest party on the right. This is neither the most proximate nor the most extreme party on the right. Other seven individuals responded that they intend to vote with North League (Lega Nord), the second most proximate party, but to their right. We also find five individuals who intend to vote for a party on the other side (left); however, this is not the most proximate party, but the biggest party on the left, the Democratic Party (Partito Democratico). One individual would vote for the Italy of Values (Italia dei Valori). There is one remaining individual that specified vote intention for UDC, as proximity theory would predict.

Considering that in Malta the most proximate party for this subset is extremely small, it is not surprising that proximity theory gets no support. An overwhelming part of the individuals who expressed their vote intention and are situated at 6 (15 out of 22) would vote for the Nationalist Party (Partit Nazzjonalista), and the remaining seven would vote for the biggest party on the left — Labor Party (Partit Laburista). In the case of Malta, they are not just the biggest parties on each side of the ideological spectrum, they are also the most extreme one. Again, it has to be noted that none of these individuals would actually vote for the party indicated by the proximity voting.

Our results in the previous subsection show that even when theories of spatial do

---

17Of course, these proportions might differ significantly if we had taken the individually perceived party positions. At least in some cases, it could be that the parties for which the vote intention was expressed would appear as being the most proximate. Nevertheless, because of the inherent projection effects, we keep the mean perceived party positions as our party position indicator throughout the whole paper.
provide different predictions for first party choice, they mostly do so based on the intensity rule. Thus, both our simulations and the data provides strong support to the findings of (Westholm, 1997). We will return to this issue in the next section.

3 Contextual variation and hypotheses

3.1 Spatial voting and party-system polarization

Under what contextual configuration do we find more spatial issue voting? The theoretical conditions for better explanatory power of spatial utility functions can be summarized in two points: when ideology or an issue is salient (1) and/or there is policy differentiation of the competing parties (2), issue voting will be stronger. The usually employed proxy for these characteristics is party-system polarization, understood as a measure of spread of parties along the ideological left-right continuum (Dalton, 2008). Increased party-system polarization describes a system in which parties emphasize their unique ideological positions and try to differentiate themselves from other competing parties (Downs, 1957). Thus, party-system polarization is a measure of ideological differentiation (Sartori, 1976). Party-system polarization is expected to intensify the debates between parties and public debate on the dimension (Sartori, 1976), and make the dimension more salient for electoral the electoral decision (Downs, 1957; Alvarez and Nagler, 2004). Simply put:\[18\]:

\[\ldots\] Issue spaces that are not compact should form the basis for voter decision making, since noncompact issues provide voters with ways to see clear and important differences between the various political parties.

Alvarez and Nagler (2004, 57)

Indeed, previous research shows that in countries with more polarized party-systems — or country sub-units (Lachat, 2011) — spatial voting theories describe better the party preferences (Lachat, 2008; Pardos-Prado and Dinas, 2010). This comes as no surprise in light of the results reported by van der Eijk et al. (2005). Also, in a follow up, Dalton (2008, 14) reports: as party-system polarization increases, the correlation between the left-right position and the vote increases heavily (\(r = 0.633\)). For our research question, this translates into the hypothesis that:

**Hypothesis 1.** Everything else held constant, as party-system polarization increases, the probability of spatial issue voting increases.

\[18\] In their analysis, Alvarez and Nagler (2004) discuss party compactness, which is essentially the inverse of polarization.
We will also define party-system polarization identical to previous comparative work on spatial issue voting — following Taylor and Herman (1971), where the polarization measure for a party system with \( K \) number of parties is:

\[
Polarization = \sum_{i=1}^{K} w_i |LR_i - \overline{LR}|
\]  

(3)

where:

\[
\overline{LR} = \text{the weighted mean of the parties' placement on the left-right scale;}
\]

\[
LR_i = \text{the position of the party } i \text{ on the left-right scale;}
\]

\[
W_i = \text{the weight attached to party } i, \text{ given by its relative;}
\]

vote share at the time of the election observed.

We use the polarization values as in Vegetti (2011). The party placement scores were calculated based on the mean perceived left-right position of each party in the European Election Study 2009. Although this survey concerns the EP elections, both the party positions of the left-right scale and the vote intention refer to the national political arena. Furthermore, the party weights reflect the vote share of each party based on the previous elections. One last aspect to mention is that this score includes only relevant parties: parties running in all the country and parties represented in the national Parliament at the time of the 2009 European Election (for exceptions see Vegetti (2011)).

Two additional points should be discussed for Hypothesis 1. On one hand, Lachat (2008) found that both proximity and directional utility functions gain in exploratory power in more polarized party-systems. On the other hand, Pardos-Prado and Dinas (2010) report that party-system polarization only benefits directional theory, with no or negative effect on the proximity utility function. At this stage of our analysis, these differences should not have any sizeable influence on our Hypothesis 1. If we accept the conclusions of Lachat (2008), spatial voting frequency should definitely increase with party-system polarization. If we follow the results of Pardos-Prado and Dinas (2010), the accuracy of directional theory should increase more — even on the detriment of proximity theory, but this overall would not change the increase of spatial voting frequency. It would simply change the ratio of spatial voting determined by directional vs proximity voting. This is due to our operationalization in which refer to spatial issue voting being activated if either proximity or directional theory (or both) offer a correct prediction of the vote intention.

Testing this hypothesis contributes in two ways to our understanding of spatial issue voting. First, it will test whether previous findings hold for the 27 multi-party systems in 2009, compared to the previously tested time periods and more restrained European

\[19\]The questionnaire refers to the individuals' vote intention if national elections would be held. Also, the perceived party position and the left-right self-placement refer to general concepts, not to EU or EP election specific quantities.
sample. Secondly, and more importantly, it will give a clear indication how much party-system polarization matters for spatial issue voting. We will be able to assess this in an intuitive way, seeing how much the probability of spatial issue voting increases with changes in party-system polarization.

3.2 Directional and proximity voting in polarized party-systems

How does the composition of spatial voting change as party-system polarization increases? Can too much differentiation create an adversarial context? In this section we discuss this questions and link them to the direct comparison between the two spatial voting theories under scrutiny. As stated above, in the case of an unconstrained approach that does not differentiate between cases where the two theories offer different predictions, the accuracy of directional and proximity theory should be influenced in the same way by party-system polarization. As said, higher party-system polarization indicates clearer divisions or differentiation between the competing parties on the given dimension. These aspects create a more fertile terrain for spatial issue voting in general (Vegetti, 2011). Yet again, in these cases we cannot decide which theory is better in describing the choice of the preferred party, because in a substantial share of cases they would predict the same party as first preference. Indeed, we regard that the percentage of non-discriminant predictions (around 75% on average) is that high, that no other expectation can be formulated, but that these two theories are influenced in the same way by party-system polarization. Hence, our second hypothesis:

**Hypothesis 2.** In the unconstrained scenario, both the vote intention prediction of proximity and directional prediction are affected positively by increasing party-system polarization.

However, party-system polarization also reflects a degree of conflictual politics (Pardos-Prado and Dinas, 2010). This is even more emphasized if we think about the formula we use for polarization. If a given party is more relevant (bigger parties) it will have a higher impact on the overall polarization score as it distances itself from the middle of the scale. Thus, in those countries where we have higher levels of party-system polarization, it is also expected that the more important parties deviate more from the middle of the scale. These parties will be relevant players in the political competition, and they will also be considered as valid choices by voters. We need to note here the problem of causal direction. As seen, in more polarized systems, bigger parties tend to be more distant from the middle point. In quite some cases, they end up being the most extreme party on one (or both) side of the ideological continuum. In this case, this will automatically lend more credence to

---

20 This extension will hold true if we find that the parameters estimated for party-system polarization are both positive and statistically significant.
directional theory\textsuperscript{21}. However, could it be that the party-system constellation or the move of relevant parties to the extremes is a result of more responsiveness to extreme positions on the individual level? If this is a plausible mechanism, we cannot necessarily argue that directional voting is increased “by” polarized party-systems. Given the data at hand, we cannot disentangle the net of complicated causal relationships possible, and thus we have to emphasize the correlational nature of our analysis. This aspect of our analysis is not different from the limitations reported by previous research in this field (Lachat, 2008; Pardos-Prado and Dinas, 2010). Finally, differentiating between non-discriminant and discriminant scenarios helps us in better understanding why there is an apparent difference in the conclusions of the previous works.

Furthermore, in more polarized party-systems we will find that people are more reluctant to switch sides in voting (Vegetti, 2011). Although the previous research tackled this problem on the aggregate level, it might have implications for the individual level. Normally, this aspect of the party-system should decrease the accuracy of proximity voting for individuals who take a position that close to the middle of the scale, but not identical to it. Nevertheless, this is only a theoretical possibility. Even if individuals are less prone to switch sides in more polarized party-systems, this should not decrease proximity voting, because of the empirical party-system constellation discussed in our previous section.

Similarly, a recent attempt to answer why some people use directional and others proximity voting (Collins, 2011) argues that individuals "transform" or reduce the perceived continuous policy space into categories, putting each candidate into one category. Then, they have proximity type preferences over categories (not necessarily candidates) and they choose the closest category to their ideal category (Collins, 2011). Thus, if the policy space is divided — by the voter’s cognitive process — into many categories, it is more probable that the voter will be a proximilist. However, if a voter uses only two categories that closely resemble the two sides of the policy space (as measured in surveys for example), the voter will be a directionalist (Collins, 2011). Based on how the party-system polarization index is operationalized and its divisive nature, we argue that in more polarized systems we can expect people to consider the political arena in fewer categories, these reflecting the divisions between left and right. In sum:

**Hypothesis 3.** When discriminating scenarios are considered, the vote intention prediction of proximity theory should be less accurate in highly polarized party-systems, whereas the vote intention prediction of directional theory is positively affected by increasing party-system polarization.

This last hypothesis has a direct implication on the comparison of the two theories.

\textsuperscript{21}Moreover, this could encourage strategic voting. This would mean that individuals disregard their closest party and prefer the biggest party on their side. If this party is the most extreme one, this strategic nature of voting will systematically increase directional voting
Ultimately, in those cases where we have discriminant prediction and there is some sort of spatial voting going on, we expect that directional theory will be positively influenced by party-system polarization, on the expense of proximity theory. Essentially, this is the accurate decomposition of the spatial voting into proximity and directional voting. Will this mean that directional voting outperforms proximity voting in more polarized party-systems? We do not have an explicit theoretical answer to this question. We can only speculate based on previously reported results. According to Pardos-Prado and Dinas (2010, 776), a change from the minimum to the maximum level of reported party-system polarization induces an increase of 0.02 in the directional function’s impact, pushing it slightly over (0.013), but suggesting that the proximity function (0.04) still prevails even in this context. This effect is in the expected direction, but given the choice of modeling we do not know anything about the changes in the proximity function’s slope across countries (in interaction with party-system polarization), and thus it is highly problematic to correctly contextualize the magnitude (and significance) of the effect on directional theory.

Nevertheless, we consider this as a guiding empirical result, and we expect that although directional voting will gain on the expense of proximity voting in the direct comparison, this might not be sufficient for it to prevail as the most frequent spatial issue voting type. We proceed with our empirical analysis in the next section.

4 Empirical analysis

4.1 Data

In order to comparatively evaluate the accuracy of proximity and directional theory, we use the 2009 European Election Studies. As noted previously, the vote intention question refers to the national elections, not to the European Parliamentary Elections, making it suitable to draw inferences about general party competition and electoral behavior. Including 27 European countries, these data present several advantages that facilitate both gaging cross-country differences and deciding in heads-up predictions of the two spatial voting theories. The survey was carried out simultaneously in the 27 countries so there are no additional time related factors that would bias the cross-country comparisons.

22 Although Pardos-Prado and Dinas (2010) make a differentiation between electoral and party-system polarization, we cannot fully test this differentiation on our data. This is due to the simple fact that for the 27 countries included in our analysis, the correlation between party-system polarization and electoral polarization was extremely high ($r = 0.73; p < 0.001$) for 2009. In light of this empirical constellation, even if we would be able to derive specific hypotheses, we cannot expect significantly diverging results. 23 For a more general setup, we will employ the following notation: $J$ reflects the total number of systems, in our case 28, whereas $n$ is the total number of individual observations in our data. We have 28 instead of 27 second level units because Belgium is split up into Flanders and the Walloon region.
As in previous research, we assume that the left-right political dimension captures the most essential parts of ideology both on the individual and on the party level. Our data contains the classic 11-point left-right political ideology scale. Also, respondents were asked to place the parties from their country on the same 11-point left-right scale. We follow previous work in order to avoid the problem of projection (Macdonald and Rabinowitz, 1997; MacDonald et al., 1997), and hence compute for each party in each system an average perceived left-right position. This party specific variable also ranges from 0 to 10, but it can take up non-integer values. With the assumption that voter positions (as asked in the survey) are discrete, but party positions are continuous, and given the voter distribution on the left-right scale we compute for each individual position two quantities: (1) what party preference would directional theory predict, if any (Directional.P), and (2) what party preference would proximity theory predict, if any (Proximity.P). Based on the country of observation and the individual’s left-right self-placement, we augment the individual level data with these two variables. As operationalized in previous sections, if any (or both) of these two theories offered a correct prediction, we tag it as spatial voting. Overall, for each individual, we compute three dichotomous variables:

\[
\text{Directional} = \begin{cases} 
1 & \text{if } \text{Directional.P} = \text{VoteIntention} \\
0 & \text{otherwise}
\end{cases}
\]

\[
\text{Proximity} = \begin{cases} 
1 & \text{if } \text{Proximity.P} = \text{VoteIntention} \\
0 & \text{otherwise}
\end{cases}
\]

\[
\text{Spatial} = \begin{cases} 
1 & \text{if } \text{Proximity} = 1 \parallel \text{Directional} = 1 \\
0 & \text{otherwise}
\end{cases}
\]

Furthermore, for each individual we store whether the two theories predicted different first party preferences as follows:

\[
\text{Discriminate} = \begin{cases} 
1 & \text{if } \text{Proximity.P} \neq \text{Directional.P} \\
0 & \text{otherwise}
\end{cases}
\]

As implemented here, this is the most conservative test of the predictive power associated with each of these two theories. We only assess whether the spatial theory predicted first party preference, and we are not benchmarking the theory based on the whole set of ranked preferences predicted. Moreover, we penalize directional theory for not offering party preference predictions for individuals on the middle point of the left-right political scale. As there are no predictions associated with directional theory for a voter in the middle position, the Directional binary variable will always be 0 if \(Left - Right_{\text{voteys}} = 5\).

We use expressed vote intention instead of vote recall because it reflects a first preference stipulated under the influence of current party-system constellation and individual status. By choosing vote intention we avoid the possible effect of changes in party-system
polarization, disappearance of parties, and any other factors that are a function of the time gap between collecting the survey and the previous national election.

### 4.2 Descriptive results

A first step in the empirical analysis is a careful look at the descriptive results\(^{24}\) presented in Figure 2. We observe substantial cross-country variation, spatial theories being least correct in Slovenia (16.86\%) and overwhelmingly accurate in Malta (71.19\%). These results offer a less daunting picture about the performance of issue voting theories in Europe, suggesting that this approach towards voter preferences still has a relatively large explanatory power. From a normative perspective, an acknowledged and represented role of ideology (or issues) in the electoral outcomes is desired, and again, it is preferred if a proximity logic underlies the choice (Powell, 2004; Thomassen and Schmitt, 1997). We see that, on average, in close to 40\% of the electoral preferences some sort of spatial-ideological logic is represented. When focusing on the extent of spatial voting, we can already establish a positive relationship between these party-system polarization and spatial voting, though not necessarily a linear one.

![Figure 2](image-url)  
**Figure 2**: Proportion of spatial voting (\(y - axis\)) plotted against party-system polarization (\(x - axis\)), based on EES 2009. The size of the labels represents the percentage of proximity voting for cases where there is spatial voting and the two theories offer different predictions. The center gravity point is given by the average proportion of spatial voting across countries and the median party-system polarization value (1.568, for Greece).

When we decompose the sources of spatial voting into directional and proximity —

\(^{24}\)We also report these proportions in table format in Appendix A.
and take into account only discriminant scenarios — we see 3 major groups of countries. We have countries — such as Austria, Bulgaria, Belgium (both systems), Denmark, Estonia, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Poland, Portugal, Slovakia — where proximity theory has a clear edge. We also have a set of countries — Czech-Republic, Finland, Luxembourg, Netherlands, Romania, Slovenia, Sweden, UK — where the two theories perform very similar to each other. Finally, we have a relatively small group of countries where the directional model is clearly a better predictor of vote intention: Cyprus, Malta, Lithuania, Spain.

Overall, we see substantial cross-country variation in spatial voting, with a relative win for proximity theory. Also, we identify that more polarized party-systems (over the median) exhibit systematically higher rates of spatial voting, and this contextual setting gives a slight edge to directional theory. Nevertheless, a multivariate account is needed to identify and evaluate the systemic differences that affect the performance of these theories.

4.3 Statistical model

In the general description we follow Gelman and Hill (2006) and use the following general hierarchical model specification:

\[ y_i \sim \mathcal{N}(X_i^0 \beta^0 + X_i B_{j[i]}, \sigma_y^2), \text{ for } i = 1, \ldots, n \]

\[ B_j \sim \mathcal{N}(U_j G, \Sigma_B), \text{ for } j = 1, \ldots, J \]

where \( X^0 \) is the \( n \times R \) matrix of individual predictors and \( \beta^0 \) is the vector of their unmodeled regression coefficients. \( X \) is the \( n \times K \) matrix of individual predictors that have coefficients varying by groups (intercept included). \( B \) is the \( J \times K \) matrix of regression coefficients. \( U \) is the \( J \times L \) matrix of group level predictors (in our case it is only a vector, \( L = 1 \)) and \( G \) is the \( L \times K \) matrix of coefficients for the group level regression (again, in our case this is a vector, \( L = 1 \)). \( \Sigma_B \) is the covariance of the varying intercepts and slopes. Given the nature of our dichotomous dependent variables, we use a logit link function. We only diverge from this specification in one respect: we do not employ a linear restriction on the effect of party-system polarization, and thus estimate smoothing splines (Keele, 2008)\(^{25}\).

We specify a total of six separate models to test our hypotheses. In our first model, the dependent variable is spatial voting, and our analysis does not differentiate between cases in which both theories were correct or only one of them. Overall, with this model we can test Hypothesis 1. We then analyze how proximity and directional voting are directly influenced by party-system polarization, without restraining our sample to discriminant scenarios, testing Hypothesis 2.

\(^{25}\)We specified models with penalized regression splines (basis being cubic regression spline) and automatic knot selection.
For our fourth and fifth model, we restrict our sample to the cases in which directional and proximity theory offered different predictions. In the fourth model, we estimate the probability of proximity voting (1) vs. no spatial voting or directional voting (0). Similarly, in the fifth model we estimate the probability of directional voting (1) vs. no spatial voting or proximity voting (0). With these two models we can evaluate Hypothesis 3 without being influenced by overlapping predictions and compare the results to the previous two models. Finally, we estimate a model in which we analyze to what extent more polarized party-systems help directional voting against proximity voting. In this case, our sample includes only cases in which we know that there is spatial voting, and the two theories offer different predictions. In this case we only need to specify one model, as directional and proximity theory are mutually exclusive. Overall, this last model reflects the direct and accurate comparison between the two spatial voting theories, contributing to previous debates on which theory is “better”, a corollary of Hypothesis 3 in our case.

All these models include five individual level predictors: left-right self placement, political knowledge, interest in politics, age, and gender. Although not of particular interest for our general research question, we employ these variables to explain individual variation and correctly link party-system polarization cross-country variation in a correctly specified model. Detailed description and descriptive statistics of these variables are presented in Appendix B. Finally, before turning our attention to the results, we report that around 9% of the variation in spatial, 7% variation in proximity, and 15% of the variation in directional voting is across-countries. Furthermore, when the sample for direct comparisons is considered, close to 23% of the variation in directional (identical for proximity voting) is between country variation, suggesting a fertile variance structure for a hierarchical model.

### 4.4 Multivariate results

According to our theory based on increased salience of the ideology (and issues) and higher policy differentiation in polarized party-systems, we expect a positive relationship between polarization and spatial voting. As reported in Figure 3 (panel A), our empiri-
Analysis confirms this expectation.

Figure 3: Effect of party-system polarization on spatial voting theories. Panel A presents the slope of polarization for spatial voting in general; panel B and panel C present the slope of polarization for proximity and directional voting, when all cases are kept in the sample. Dashed lines: 95% confidence intervals. The party-system polarization median value is 1.568 (Greece). All other individual level covariates are set to their mean, respectively gender is male.

Analyzing 28 European multi-party systems, we find a substantive and statistically significant positive effect of party-system polarization on spatial voting: the probability that spatial voting is employed increases from around 0.2 in depolarized political systems to above 0.6 in highly polarized party-systems — everything else held constant. However, a more realistic interpretation takes into account that only very few countries score that high on polarization that our model would predict above 0.5 probability for spatial voting. For example, in a system with moderate party-system polarization (such as the Finland, Romania, or UK) the predicted probability of spatial voting of around 0.25, whereas for the same individual in countries with above average polarization (such Bulgaria, Hungary, or the Czech-Republic) this value will be closer to 0.4. Consequently, we see what those hard-to-interpret cross-level interactions meant in previous analysis in terms of probabilities of spatial voting across countries. No matter how conservative is our interpretation, we find strong empirical evidence that when parties offer better differentiated policy stances on the left-right political dimension, this policy considerations holds true for directional and proximity voting as well, if we do not restrain our sample for discriminant predictions. The controls for gender and age display mixed results depending on which sample we use for analysis. Overall, we see that women tend to be less “directional” than men, and as people get older they more often follow a proximity logic than a directional one.

Similar to Lachat (2008), we find that more interested and politically more informed individuals are also more prone to follow a spatial logic in choosing their representatives. Full model results are reported in Appendix C.

Based on our analysis we suspected that Cyprus (with a score of over 3 for party-system polarization) is an outlier. Thus, we re-specified our model without including Cyprus. Both the magnitude and the statistical significance of party-polarization’s effect remained basically unchanged.
aggregated by the left-right ideological continuum matter more in the electoral decisions of individuals. Yet again a note of caution is needed in the interpretation. We see that varying levels of party-system polarization are associated with different predicted probabilities for spatial voting. This covariation is suitable to explain only cross-country variation in spatial voting. It is not possible to think of these results in terms of how much spatial voting will drop after a depolarizing trend in a given country. We have to note that changes of 0.5 or 1 in the party-system polarization for a given country would mean quite a reshuffling of the existing party-system with either emergence and consolidation of new parties, or disappearance or merging of existing parties. In highly institutionalized Western European party-systems it is unlikely to find these major changes in a realistically short period of time.

With empirical support for our Hypothesis 1, we evaluate now whether proximity and directional theory is affected systematically differently by party-system polarization. As discussed before, we specify two hierarchical models with proximity and directional as dependent variables, first without restraining our sample. When proximity (directional) takes the value 1 we don’t know whether directional (proximity) theory made a bad prediction. We see in Figure 3, panel B and panel C that both theories gain in more polarized party-systems. Generally, directional voting is far less probable in depolarized systems compared to proximity voting, but increasing party-system polarization has a stronger beneficial effect on it. Towards very high levels of party-system polarization, both vote choice strategies will be similar in extent. Overall, this only means that for directional voting to be comparable in magnitude to proximity voting, higher levels of party-system polarization are necessary. Our results regarding proximity voting suggest that the policy differentiations salience effect is still present, and does not necessarily disappear with increasing centrifugal party competition (and implicitly more adversarial competition). In this sense, we find confirmation of the hypothesis that as party-system polarization increases both the spatial voting theories benefit from this aspect. However, as in over 75% of the cases these two theories offer the same prediction, we contend that this result is driven by this impossibility to discern between the two theories. This is even more plausible if we think back to Figure 1, where we see that there are no discriminant predictions on the two relative ends of the ideological continuum. Consequently, the positive results displayed based on our second and third models are expected to be generated by increasing accuracy of the two theories exactly on these side segments of the continuum.

For this reason, we restrained our sample to discriminant cases only for the next two models. Accordingly, when proximity (directional) takes the value 1 we know that directional (proximity) theory made a bad prediction. However, when proximity (directional) is 0, we cannot be sure (yet) whether the directional (proximity) model was right in predict-
Figure 4: Effect of party-system polarization on competing spatial voting theories. For panels (A) and (B) the sample is restricted to discriminant scenarios. For panel (C) the effect is modeled on the subsample for which we found that (1) one of the spatial voting theories is correct and (2) the two theories offer different predictions. These latter results reflect the direct, heads-up comparison between proximity and directional theory. The two slopes are identical in magnitude, but with opposite signs. We plot both to display till what point can we differentiate between them. Dashed lines: 95% confidence intervals. The party-system polarization median value is 1.568 (Greece). All other individual level covariates are set to their mean, respectively gender is male.

ing the first party preference. Thus, this is not yet a direct, heads-up comparison between the two theories. It is a step in which we can evaluate the effect of party-system characteristics without being influenced by the overlapping predictions. When controlling for discriminant predictions, we see in Figure 4, panels A and B that only directional theory gains in more polarized party-systems. The magnitude of this gain is, however, limited: from a close to 0 probability of directional voting in depolarized systems to a roughly 0.2 probability in the most polarized party-systems. More telling is the approximately 0.1 probability of directional voting at the median level of party-system polarization. The slight negative effect of party-system polarization on proximity voting does not reach statistical significance, and predicted probability of proximity voting is somewhere around 0.2 - 0.25, independent of the level of party-system polarization. One possible interpretation of this result is that proximity voting is resistant to more adversarial political contexts. Even if there is more accentuated competition with relevant political options diverging even to the extremes of the ideological continuum, a fair amount a proximity voting will be present. Again, this result is encouraging from a normative perspective that stipulates the desirability of choosing representatives that are “congruent” on policy stances with the voter (Adams and Merill, 2005; Powell, 2004; Thomassen and Schmitt, 1997). Furthermore, this normative approach does not require the differentiation between non-discriminant and discriminant scenarios. No matter whether directional theory predicts the same first preference, when there is proximity voting, the benefits of representatives that are congruent with the voter are present.
Our contribution till this point clarifies and extends the conclusions elaborated by Pardos-Prado and Dinas (2010). As stated before, Pardos-Prado and Dinas (2010) did not assess in their analysis the interaction between the proximity functional form and party-system polarization, thus we had no indication whether this theory “suffers” under a context characterized by a more polarized party-system. Furthermore, Lachat (2008) reported that the proximity function gains in explanatory power as party-system polarization increases, and based on these diverging results we were left in a dilemma. Our empirical analysis clearly suggests that proximity voting benefits from party-system polarization, but not as much as directional theory. However, even if the slope of party-system polarization is steeper for directional voting, this is only sufficient to compensate for its relatively low probability in depolarized systems (as displayed in Figure 3). But these are only “illusory” gains for proximity theory. As discussed above and displayed in panels A and B of Figure 4, proximity theory only gains because of the overlapping predictions with directional theory. The final remaining question is how would these two theories compare against each other directly. Our last model aims at bringing empirical evidence to settle this dilemma.

For the direct comparison, we restrained our sample to those cases in which only one of the two theories offered a correct prediction. Consequently, in this sample we have cases where there is spatial voting and discriminant predictions are offered by the two theories. Party-system polarization has a statistically significant and substantive effect in this case as well. Panel C in Figure 4 displays this effect. Indeed, in the direct comparison, directional theory gains in substantially from increasing party-system polarization: from 0.1 probability in the lowest party-system polarization range to 0.7 in the highest. Correspondingly, proximity voting decreases from around a probability of 0.9 to 0.3.

Yet again, although these results are in conformity with those reported by Pardos-Prado and Dinas (2010), the interpretation must take into account carefully the values of party-system polarization. In this sense, the conclusions for directional theory are not that bright. In order for directional voting to reach the same prevalence as proximity voting (0.5 probability value), there has to be a relatively high party-system polarization. The only countries that are sufficiently polarized are Cyprus, Malta, and the Czech-Republic. Moreover, given

32 As discussed previously, we are unable to meaningfully test the effect of electoral polarization on these two theories, because in our data party-system polarization and electoral polarization is highly correlated ($r = 0.73, p < 0.001$).
33 For this last model, the probabilities (or frequencies) are values that reflect solely on cases where there is spatial voting going on. For example, in Greece the predicted probability of directional voting in our last model is around 0.25. This would mean that, with the necessary statistical uncertainty, around 25% of the spatial voting in discriminant scenarios is directional. This does not mean that there 25% of the vote intentions is described accurately by directional theory. This quantity is below 10% in discriminant positions (see panel B in Figure 4), or just slightly above 10% in non-discriminant scenarios (see panel C in Figure 3).
34 Ireland, Spain, Hungary also have party-systems that are very polarized, and would push the predicted
the model based uncertainty of these estimates, we cannot really distinguish between the two theories in segments where party-system polarization is higher than 2. This implies that when comparing these two theories, we must offer only very restrained conclusions or verdict. We can say with certainty that proximity theory is a better descriptor of electoral intentions than directional theory, but the gap between them decreases (linearly) as party-system polarization increases. The turning point from where directional voting is more frequent than proximity voting is in a very high domain of the party-system polarization score, and estimation uncertainty makes it impossible to determine a clear winner in this segment. We discuss the implications of these findings to the broader scope of comparative spatial voting in the next section.

5 Discussion and conclusions

In the present paper we investigated the frequency of two major spatial voting theories in 27 European countries. We departed from the classical method of analysis that employs spatial utility functions as preference descriptors, and we focused only on the first party preference. Taking this avenue, we argued that it paints an easily understandable and important picture on the actual role of spatial voting theories in electoral decisions. Secondly, we wanted to offer an approach that can incorporate the problem of overlapping predictions offered by proximity and directional theory. If both theories predict the same first party preference, it is very hard to discern which one is at play when individuals decide about their electoral choices. Intuitively, overlapping predictions appear on the relative sides of the ideological continuum: those for who are farther away from the middle of the left-right scale, the most extreme party on that side will also become the most proximate one. As seen, this is contingent on the party-system constellation in each country. Furthermore, as our analysis reveals, the success or failure of these two spatial voting theories also depends on party-system characteristics. In line with previous research by Lachat (2008, 2011) and Pardos-Prado and Dinas (2010), we concentrated on the role of party-system polarization on the left-right ideological spectrum.

As a first step, our main interest was in spatial voting in general, described by situations in which proximity and/or directional theory predict a first preference that is identical. The probability of directional voting to around 0.45. However, in these cases proximity voting still outperforms directional voting.

35 Two additional aspects were considered in the empirical analysis. We ran the same models but included to a control variable for closeness to a party. This is a rough control for possible valence effects. Our results were identical. Secondly, following the work of Schmitt and Scheuer (2012), we included a second level control variable to differentiate between established Western-European countries Post-Communist countries. As expected, spatial voting based on the left-right is more frequent in established democracies, but this effect did not reach statistical significance. Even with this additional country level control our results remained unchanged.
tical to the individual’s vote intention. We have found that, on average, in close to 40% of the cases there is spatial voting going on. Of course, this percentage is much higher for politically more informed and interested individuals, a finding that is in accordance that for spatial voting information and at least some cognitive effort is needed. More importantly, we saw that when the party-system is more polarized and there is actual differentiation between party proposals and positions, spatial voting becomes more frequent. These findings are in line with those reported by Lachat (2008), but are easily quantifiable: there is an increase from 20% spatial voting in depolarized systems to around 60% in highly polarized party-systems. These findings lend further credence to the hypothesis that ideology (and issues, respectively) are more important in the electoral decision making when the political discussion is salient about them and the supply-side alternatives are indeed real alternatives. But should the two very different spatial theories be influenced in the same way by increasing party-system polarization? We offered a classical “it depends on the assumptions” sort of an answer. We believe that this does not take away from the merits of either of these theories, and does not reduce the implications of the present research.

If our main concern is a normative one determined by the desirability of ideological congruence between individual and preferred party, we should not be concerned with the discriminant predictions. Even if the two theories offer overlapping predictions, if proximity theory is right then the individual will prefer the closest party, satisfying the normative imperative of ideological congruence. However, and we stressed this aspect throughout the paper, this does not help in understanding which spatial voting type is generating that first preference. Our results suggest that if our goal is to compare the accuracy of these two theories and we focus on discriminant scenarios, proximity voting is not influenced by party-system polarization. Conversely, directional theory registers statistically significant but rather small gains as party-system polarization increases. In this sense, even if the political debate is tense, produces more extreme bigger parties, or there are tenets of adversarial politics, the segment of people choosing the parties closest to them remain relatively stable. Thus, even in more divisive political contexts, proximity voting remains frequent. The final stage of our analysis focused on the direct comparison between the two spatial voting theories. If we consider the necessity of discriminant predictions and statistical uncertainty, our general conclusion must be very low-key. This depicts that ubiquitous situation in which previous research was neither fully wrong, nor entirely right. Based on our results, conclusions such as the people are more responsive to extreme policy positions than to proximate ones in polarized party-systems are unwarranted. However, this does not mean that directional voting is not “helped” by increasing levels of party-system polarization, just that this help is not enough to clearly outperform proximity voting. A realistic consideration of party-system polarization scores suggests that directional theory matches up to proximity voting only in very few countries (Cyprus,
Malta, and the Czech-Republic) and in these cases model based uncertainty makes it impossible to distinguish between the fitness of the two spatial voting theories. Clearly, directional voting moves from a being an improbable type of spatial voting (0.1) in depolarized party-systems to around 0.3 in above average ranges of party-system polarization, and it does this on the cost of proximity voting. Finally, we shall reiterate that even considering only discriminant scenarios, our comparisons are limited. They are limited, because we can only test the intensity rule of directional theory, simply because in the current party-system constellations there are no real cases for which the most proximate political party would be on the other side of the neutral point.

En sum, our analysis brings more empirical support for proximity voting than directional voting in the 28 European multi-party systems presented. It does this by clearly differentiating between those cases where it is possible to compare proximity and directional voting and where this is impossible. Although both are spatial voting theories, the individual level decision-making mechanisms are very different and they would suggest different emerging party positions for vote maximization. This was our main reason to offer an analysis in which clear differentiation between the two theories is incorporated in the empirical study. All these constraints in our analysis further enhance our understanding of both the amount of spatial voting in Europe, and their composition across countries, and how this depends on contextual factors.
References


## Appendices

### A Descriptive results

<table>
<thead>
<tr>
<th>Country</th>
<th>% Overall spatial voting</th>
<th>% of proximity if diff. and corr.</th>
<th>Polarization</th>
</tr>
</thead>
<tbody>
<tr>
<td>AT</td>
<td>22% 140</td>
<td>84% 95/113</td>
<td>1.409</td>
</tr>
<tr>
<td>BE-F</td>
<td>21% 78</td>
<td>100% 56/56</td>
<td>0.485</td>
</tr>
<tr>
<td>BE-W</td>
<td>32% 82</td>
<td>89% 41/46</td>
<td>1.041</td>
</tr>
<tr>
<td>BG</td>
<td>42% 234</td>
<td>69% 55/80</td>
<td>2.109</td>
</tr>
<tr>
<td>CYP</td>
<td>68% 469</td>
<td>34% 39/114</td>
<td>3.106</td>
</tr>
<tr>
<td>CZ</td>
<td>56% 345</td>
<td>53% 69/129</td>
<td>2.585</td>
</tr>
<tr>
<td>DK</td>
<td>22% 186</td>
<td>89% 129/145</td>
<td>1.679</td>
</tr>
<tr>
<td>EE</td>
<td>35% 181</td>
<td>88% 46/52</td>
<td>1.260</td>
</tr>
<tr>
<td>FIN</td>
<td>43% 299</td>
<td>63% 79/125</td>
<td>1.363</td>
</tr>
<tr>
<td>FR</td>
<td>21% 109</td>
<td>89% 83/93</td>
<td>1.806</td>
</tr>
<tr>
<td>GER</td>
<td>47% 315</td>
<td>67% 113/170</td>
<td>1.438</td>
</tr>
<tr>
<td>GRE</td>
<td>40% 266</td>
<td>91% 183/202</td>
<td>1.568</td>
</tr>
<tr>
<td>HUN</td>
<td>25% 157</td>
<td>79% 93/117</td>
<td>2.370</td>
</tr>
<tr>
<td>IRE</td>
<td>32% 213</td>
<td>97% 57/59</td>
<td>0.907</td>
</tr>
<tr>
<td>ITA</td>
<td>27% 147</td>
<td>98% 127/129</td>
<td>2.125</td>
</tr>
<tr>
<td>LAT</td>
<td>19% 91</td>
<td>84% 56/67</td>
<td>1.510</td>
</tr>
<tr>
<td>LIT</td>
<td>54% 171</td>
<td>19% 4/31</td>
<td>1.642</td>
</tr>
<tr>
<td>LUX</td>
<td>34% 210</td>
<td>47% 38/80</td>
<td>0.949</td>
</tr>
<tr>
<td>MT</td>
<td>71% 257</td>
<td>0% 0/21</td>
<td>2.393</td>
</tr>
<tr>
<td>NL</td>
<td>21% 167</td>
<td>57% 59/103</td>
<td>1.381</td>
</tr>
<tr>
<td>PL</td>
<td>46% 246</td>
<td>75% 88/118</td>
<td>1.341</td>
</tr>
<tr>
<td>PT</td>
<td>47% 285</td>
<td>85% 211/247</td>
<td>1.906</td>
</tr>
<tr>
<td>RO</td>
<td>23% 108</td>
<td>40% 6/15</td>
<td>1.171</td>
</tr>
<tr>
<td>SLO</td>
<td>16% 114</td>
<td>64% 39/62</td>
<td>1.849</td>
</tr>
<tr>
<td>SPA</td>
<td>39% 263</td>
<td>9% 5/57</td>
<td>2.290</td>
</tr>
<tr>
<td>SVK</td>
<td>26% 159</td>
<td>79% 50/63</td>
<td>1.567</td>
</tr>
<tr>
<td>SWE</td>
<td>47% 370</td>
<td>47% 76/162</td>
<td>2.024</td>
</tr>
<tr>
<td>UK</td>
<td>39% 253</td>
<td>46% 38/84</td>
<td>1.026</td>
</tr>
</tbody>
</table>

All percentages based on EES 2009 and calculated as valid percentages excluding missing values. The differences between the overall spatial voting count and the total counts in parentheses in column 3 show in how many of the spatial voting cases both theories offered the same prediction. The percentage of correct directional prediction can be calculated by subtracting the proximity share in column 3 from 100%. These are the source data for Figure 2.
B Independent variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coding</th>
<th>$\mu$</th>
<th>$\sigma$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left-right self placement self placement</td>
<td>0 - Left, 10 - Right</td>
<td>5.33</td>
<td>2.72</td>
</tr>
<tr>
<td>Political information</td>
<td>From lowest (0) to highest (1) information Linearly rescaled from 0-7 based on number of correct answers</td>
<td>0.56</td>
<td>0.26</td>
</tr>
<tr>
<td>Interest in politics</td>
<td>0-no interest, 1-high interest Linearly rescaled from 0-4</td>
<td>0.52</td>
<td>0.30</td>
</tr>
<tr>
<td>Gender</td>
<td>0-Male, 1-Female</td>
<td>0.55</td>
<td>0.49</td>
</tr>
<tr>
<td>Age</td>
<td>Age in years</td>
<td>50.29</td>
<td>16.91</td>
</tr>
<tr>
<td>Party-system polarization</td>
<td>Calculated using Equation 3</td>
<td>1.65</td>
<td>0.58</td>
</tr>
</tbody>
</table>

All variables were grand mean centered for the multivariate analysis. Age was recoded as $(value - \mu_{age})/2\sigma_{age}$ for more meaningful coefficients, and thus the effect reflects a change in the response variable when age changes from one standard deviation below the mean to one standard deviation above the mean. Both $\mu$ and $\sigma$ are calculated on the unrestrained sample. As we employ the direct comparisons, these two parameters also change, because the sample will be reduced to discriminating scenarios.

C Hierarchical model results — logit coefficients

For all models, grand mean centering was employed. For the Comparison model, the signs of the coefficients reflect the effects on directional voting; effect sizes are identical for the proximity model with opposite signs. Pure proximity and Pure Directional are the models when we restricted our sample to the discriminant scenarios (but spatial voting is not a necessary condition). These models accompany the reported polarization effects from Figures 3 and 4. All models fit better than the null-models (not reported here), and adding party-system polarization as a second level predictor always increases model fit. As seen in the figures, there is only slight non-linearity (for the directional models especially), but the non-linear models do not bring any significant increase in model fit compared to the linear models.
### Multilevel model results

<table>
<thead>
<tr>
<th></th>
<th>Spatial</th>
<th>Proximity</th>
<th>Directional</th>
<th>Pure Proximity</th>
<th>Pure Directional</th>
<th>Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed effects</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Intercept)</td>
<td>−0.70***</td>
<td>−0.96***</td>
<td>−1.70***</td>
<td>−1.59***</td>
<td>−2.51***</td>
<td>−0.77**</td>
</tr>
<tr>
<td></td>
<td>(0.11)</td>
<td>(0.11)</td>
<td>(0.21)</td>
<td>(0.18)</td>
<td>(0.17)</td>
<td>(0.29)</td>
</tr>
<tr>
<td>Left-right</td>
<td>0.11*</td>
<td>0.11*</td>
<td>0.18*</td>
<td>0.04*</td>
<td>0.37***</td>
<td>0.23***</td>
</tr>
<tr>
<td></td>
<td>(0.05)</td>
<td>(0.05)</td>
<td>(0.07)</td>
<td>(0.02)</td>
<td>(0.04)</td>
<td>(0.04)</td>
</tr>
<tr>
<td>Interest</td>
<td>0.35***</td>
<td>0.37***</td>
<td>0.54***</td>
<td>0.39***</td>
<td>0.38*</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>(0.07)</td>
<td>(0.07)</td>
<td>(0.13)</td>
<td>(0.10)</td>
<td>(0.16)</td>
<td>(0.00)</td>
</tr>
<tr>
<td>Information</td>
<td>0.35***</td>
<td>0.27***</td>
<td>0.26**</td>
<td>0.15</td>
<td>0.16</td>
<td>−0.04</td>
</tr>
<tr>
<td></td>
<td>(0.08)</td>
<td>(0.08)</td>
<td>(0.10)</td>
<td>(0.12)</td>
<td>(0.18)</td>
<td>(0.21)</td>
</tr>
<tr>
<td>Gender</td>
<td>−0.03</td>
<td>−0.003</td>
<td>−0.10*</td>
<td>0.12*</td>
<td>−0.07</td>
<td>−0.12</td>
</tr>
<tr>
<td></td>
<td>(0.04)</td>
<td>(0.04)</td>
<td>(0.07)</td>
<td>(0.06)</td>
<td>(0.08)</td>
<td>(0.10)</td>
</tr>
<tr>
<td>Age</td>
<td>0.02</td>
<td>0.11**</td>
<td>0.05</td>
<td>0.07</td>
<td>−0.24**</td>
<td>−0.26**</td>
</tr>
<tr>
<td></td>
<td>(0.04)</td>
<td>(0.04)</td>
<td>(0.04)</td>
<td>(0.06)</td>
<td>(0.08)</td>
<td>(0.10)</td>
</tr>
<tr>
<td>Random effects</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(StdDev)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>0.56</td>
<td>0.53</td>
<td>1.06</td>
<td>0.91</td>
<td>0.84</td>
<td>1.44</td>
</tr>
<tr>
<td>Left-right</td>
<td>0.24</td>
<td>0.24</td>
<td>0.37</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>N</td>
<td>16329</td>
<td>16329</td>
<td>16329</td>
<td>8497</td>
<td>8497</td>
<td>2701</td>
</tr>
<tr>
<td>Groups</td>
<td>28</td>
<td>28</td>
<td>28</td>
<td>28</td>
<td>28</td>
<td>28</td>
</tr>
<tr>
<td>AIC</td>
<td>74369</td>
<td>76115</td>
<td>86374</td>
<td>40463</td>
<td>48918</td>
<td>13218</td>
</tr>
<tr>
<td>logLik</td>
<td>−37172</td>
<td>−38045</td>
<td>−43175</td>
<td>−20222</td>
<td>−24449</td>
<td>−6599</td>
</tr>
</tbody>
</table>

Standard errors in parentheses

† significant at $p < .10$; *$p < .05$; **$p < .01$; ***$p < .001$