

Do Primaries Work?

Candidate Positioning and Representation in Nominating Elections

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Abstract

In contemporary electoral politics in the U.S., primary elections are widely believed to play a crucial role. Many scholars believe that primary election competition is the standout reason why classic predictions from formal models of electoral competition—that candidates take ideological positions near the median voter—fail to manifest in the real world. The general election context provides incentives for candidates to take centrist policy positions, but candidates must win their party’s nomination before advancing to the general election. Because primary elections take place predominantly among voters of one political party affiliation, and because those voters tend to hold strongly partisan beliefs about political issues, candidates feel more acute incentives to take strong partisan stances on issues rather than moderate stances even amid stiff general election competition.

This story of primary elections and representation is widely believed, but is it true? Despite its prominence, the empirical evidence is unclear. The theory rests on a notion that voters make informed choices in primary elections by consulting their policy preferences and choosing the candidate with the closest policy platform. Past research has been unable to operationalize key constructs in this prediction, or it has operationalized the wrong constructs. Candidates should take more extreme positions when the primary constituency has a stronger preference for ideologically extreme policy, but studies have not directly measured the policy preferences of partisans within a candidate’s district. Further, districts where partisans hold more extreme preferences should nominate candidates with more extreme campaign positions as well, but methods for estimating candidates’ ideological positions have been incompletely applied to the study of primaries. Moreover, because primary elections are characterized by low levels of voter information and the partisanship of candidates is held largely constant, non-policy forces such as candidate valence and campaign spending may be more powerful than in general elections. For these reasons, the proposition that primary elections advance the ideological interest of local partisan voters is theoretically contestable.

This dissertation develops and applies new Bayesian approaches for estimating both constructs that have yet eluded the study of primary politics: the preferences of partisan voters as a group and the campaign positioning of primary candidates. With these estimates in hand, I explore the relationship between local partisan preferences and primary candidate positions. Do primary candidates position themselves relative to partisan primary voters, and is the relative extremism of partisan constituencies related to the ideological positions of the candidates they nominate?

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Acknowledgments

I owe sincere thanks to those who supported this work. There are those who helped me professionally:

- My committee: Barry Burden, Ken Mayer, Ellie Powell, Alex Tahk, and _____ somebody
- Members of the department who provided institutional support: the “Beasts of Burden” roundtable group, Scott Straus, members of the Fall 2016 prospectus workshop course, including Micah Dillard, David Greenwood-Sanchez, Devin Judge-Lord, Dmitri Kofanov, Michael Masterson, Ben Power, Sujeong Shim, and the Election Research Center _____ others? for financial support.
- Faculty and students at other universities who shared data or provided advice at various stages in its development: Robert Boatright, Devin Caughey, David Doherty, Seth Hill, Gary Jacobson, Georgia Kernell, Brendan Nyhan, Andrew Reeves, Michael Ting, Sarah Treul, _____ Others
- Software users and developers whose tools (and supporting community) brought the project to “operational” life and influenced my work going forward: Mara Averick, Jenny Bryan, Andrew Heiss, Mike Kearney, Thomas Lin Pederson, Kara Woo, _____ Others/sp
- The staff at various cafes in town that fueled and powered me, especially Black Locust Cafe and Johnson Public House.

I also want to thank those who provided social support as this project came to a head:

- My family, who would do anything in their power for me
- My closest friends in the program: Micah Dillard, Jordan Hsu, Rachel Jacobs, Anna Meier, Anna Oltman, Rachel Schwartz
- The Bike Gang: Josh Cruz and Erin Nelson
- My friends in other cities who always cheered me on: Marissa Finazzo, Zach Gray, Spencer Melgren, Jake Moore, Daniel Putman, Ian Servantes, India Watts

Chapter One

Primary Elections and Ideological Choice

Elections are the foremost venue for citizens to influence government actors and public policy. Classic theories of voting suggest that citizens weigh the policy positions of alternative candidates and vote for the candidate whose platform most closely aligns with their own preferences (Downs 1957). Political parties simplify the voter's calculations by providing a powerful heuristic in the form of the party label, enabling voters to infer candidates' values and issue positions without expending the effort to thoroughly appraise each campaign (Campbell et al. 1960; Green, Palmquist, and Schickler 2002; Rahn 1993).

The rise of partisan polarization, however, has complicated the role of parties in U.S. politics. Although citizens, journalists, pundits, and even elected leaders frequently bemoan the bitter rhetoric and legislative gridlock that has accompanied the widening partisan divide, political scientists have identified a number of positive representational consequences to polarization. Compared to the parties of the early- and mid-1900s that political scientists believed were alarmingly undifferentiated (American Political Science Association 1950), in recent decades the Democratic and Republican Parties have taken increasingly divergent and oppositional stances across a wider variety of issues. Voters have "sorted" into partisan groups that occupy distinct ideological locations in American politics, leading to greater consistency in their issue beliefs, greater ideological abstraction in voter attitudes, and increased political participation (Abramowitz and Saunders 1998; Fiorina, Abrams, and Pope 2005; Layman and Carsey 2002; Levendusky 2009).

Even as polarization has strengthened many aspects of inter-party representation, it affects within-party representation in a number of troubling ways. Party labels provide starker informational and identity cues about candidates than in decades past, but for the typical voter, there is not much of a decision to be made. The typical voter is a partisan who intends to cast her ballot for her preferred party, whoever that candidate may be (Bartels 2000; Petrocik 2009). As party-line voting has increased, there is a sense in which polarization exacerbates the notion of partisan electoral “capture.” For most voters, their choices are locked in long before Election Day. Candidates from their preferred parties have been selected through a nomination process, and voters are more likely to abstain from voting when faced with an undesirable candidate than they are to vote against their parties (Hall and Thompson 2018). Recent research supports this notion of capture amid polarization—when voters must choose between polarized candidates, they become less responsive to candidates’ actual platforms and instead are more influenced by motivated reasoning and partisan teamism (Rogowski 2016). Voters relax their ideological scrutiny of candidates to cast low-cost votes for their own party, weakening the influence of policy preferences in electoral representation overall.

This presents an important problem for our understanding of how elections contribute to the representation of voter preferences in government. Elections are intended to be a voter’s choice over alternative political values to be expressed in government, but if the choice of candidates does not present the average partisan voter with realistic alternatives, how should we think about the “representation” of these voters’ actual policy preferences? If general elections are relatively weak venue for democratic accountability, does the U.S. electoral system incorporate these preferences in other ways?

When the choice before voters in the general election does not present realistic alternatives, political scientists naturally shift their focus to the nomination of partisan candidates. V.O. Key, for example, famously studied one-party rule in the American South, asking whether

competition within the Southern Democratic Party could provide a quality of representation similar to two-party competition (Key 1949). Although scholars are right to examine within-party competition, focusing on single-party dominance is a serious limitation. Within-party representation presents interesting questions that apply to far wider contexts. Even in races between viable candidates from both major parties, within-party competition plays a crucial role simply due to the fact that partisan voters almost certainly cast a vote for their own party. Rank-and-file partisan constituents are all but captured—if they are to express their policy preferences through the act of voting, their voices may register as relatively weak because they present little electoral risk to their party in the general election. The nomination stage—the primary election in particular—remains an important venue for the representation of partisans’ policy views, whether the general election is closely contested or not.

what am I saying here?

This dissertation is chiefly concerned with the policy preferences of partisan voters and their role in electoral representation through primary politics. The study of American electoral politics has not ignored the representational function of primary elections (Aldrich 2011; Cohen et al. 2009; Geer 1988; Norrander 1989), but as I discuss below, the quantifiable impact of primary voters’ policy preferences in government is a startlingly open question. Several existing studies have examined other aspects of primary representation, such as the introduction of the direct primary (Ansolabehere et al. 2010), how candidates position themselves in response to the presence or threat of primary challenges (Brady, Han, and Pope 2007; Burden 2004; Hirano et al. 2010), and how primary nomination rules affect elite polarization (Hirano et al. 2010; McGhee et al. 2014; Rogowski and Langella 2015). Though these studies address interesting aspects of electoral representation and party competition, they cannot speak directly to the influence of voter preferences on (1) the positioning of candidates and (2) the outcomes of primary elections.

punch up or just preview?

The absence of voter preferences from the empirical study of primaries is troubling because they play a crucial role in the dominant theory that relates representation to primary

politics. Although the Downsian model of candidate positioning explains the incentives for candidates to stake out moderate policy positions to cater to the ideological “median voter” (Downs 1957), candidates behave differently in the real world. Instead, candidates engage in highly partisan behavior and take divergent issue stances even on salient local issues and in closely competitive districts (Ansolabehere, Snyder, and Stewart 2001; Fowler and Hall 2016). But why? Scholars and political observers have argued that because competing in the general election requires each candidate to clinch their party’s nomination contest, these candidates face a combination of convergence-promoting and divergence-promoting incentives. Primary elections tend to be dominated by partisan voters who are attentive to politics and hold stronger, non-centrist issue preferences compared to the average general-election voter.¹ As a result, competition in the primary stage may present a more acute electoral threat to partisan candidates than general elections do—a “strategic-positioning dilemma” that leads candidates to take ideological issue stances in favor of convergent stances that target the median voter (Aldrich 1983; Brady, Han, and Pope 2007; Burden 2004; Hill 2015).

considered cites in
nment

I argue that if we were to construct ideal tests for this theory, the preferences of partisan primary voters play a key role. First, the theory predicts that candidates strategically position themselves to appeal to primary voters. That is, if we could construct an ideological summary of the partisan primary voters in a district, we ought to find that the level of voter conservatism affects the conservatism of the primary candidates’ campaign stances. And second, if primary voters present a credible threat to primary candidates (specifically via their policy preferences), they should vote for the candidate who best represents their policy views. We should observe

¹Primary elections are not *entirely* partisan affairs. States vary in their regulations that primaries be “closed” to partisan voters only, that voters must preregister with their preferred party to vote in the primary, and even whether primaries are partisan at all (see McGhee et al. 2014 for a thorough and contemporary review of these regulations). Although many observers suspect that regulations on primary openness greatly influence the ideological extremity of the primary electorate, recent survey research finds that these regulations do little to moderate the strong partisan composition of primary voters (Hill 2015).

that as the degree of primary voter conservatism increases, the probability that a more conservative candidate is nominated increases as well. These two predictions are the core empirical implications of the “strategic positioning dilemma” theory of representation in primaries, and they each require researchers to know the preferences of partisan voters within an electoral district. Yet, the preferences of the partisan constituency are either absent or dangerously misconstrued in the existing literature, and we have been unable to answer these key questions as a result.

Stated differently, this dissertation asks if primaries “work” the way we think they do. It is widely believed that primaries are effective means for voters to inject their sincere preferences into the selection of candidates and, in turn, the priorities of elected officials. Is this *actually* true? Do candidates position themselves to win the favor of primary voters? Do primary voters select the candidate who best represents their issue beliefs? And further, do institutional factors that purportedly alter the positioning incentives of candidates, such as redistricting, affect which candidates are nominated?

Not only is the evidence in support of this theory sparse or indirect,² its theoretical plausibility is not straightforward either. Primary elections present voters with uniquely high informational demands. Because most primary elections are held between candidates of the same party,³ the party label does not provide the same heuristic cue for voters to impute the positions of the candidates. Although primary voters are generally informed about the typical policy positions associated with their preferred party (Hill 2015), the costs of learning about which candidate stands for which position will be higher than the information costs in a general election. Primary elections typically occur in odd months when voters are paying less attention to politics, and the press typically cover primary campaigns less closely than

²I elaborate on the existing evidence later in this chapter.

³There are a few exceptions to this general characterization of nomination elections. California, Louisiana, and Washington hold blanket primaries, sometimes called “jungle” primaries, where candidates from all parties compete on one ballot to be included in a runoff general election.

general election campaigns. In these low-information environments, voters may decide to cast their ballot for various non-policy reasons. They may vote for the familiar candidate instead of the ideologically proximate one, in which case asymmetric campaign expenditures or news coverage may advantage one candidate over the other. Candidates may determine that communicating their policy positions is less cost-effective than communicating symbolic positions by touting their incumbency or their “outsider” status. The efficacy of these appeals may be correlated with the actual ideological positions of the candidates (for example, if high-quality incumbents are more skilled at perceiving primary voter preferences, (On the perception of voter preferences by politicians, see Broockman and Skovron 2018.) positioning themselves in relation to primary voters, and at communicating symbolically powerful messages), but the information voters are acting on is itself non-spatial. In short, although the proposition that voters’ policy preferences affect their primary candidate choices seems straightforward, the informational environment of the primary campaign presents voters with many incentives to vote using non-policy considerations. Indeed, the notion that “voters matter” is a theoretical orientation toward primaries that is not shared by all scholars of electoral representation. Many scholars of political parties maintain that parties retained their gatekeeping roles over party nominations even as the direct primary ostensibly removed their formal powers over candidate selection. Although primary campaigns take place, these scholars argue that an informal network of party actors wields enormous influence behind the scenes, controlling which candidates obtain access to the party’s resources, donor lists, and partisan campaign labor (Cohen et al. 2009; Masket 2009).

There are two dominant obstacles that have kept the primary constituency from assuming its proper role in the the study of representation. First, and most importantly, the dominant conceptualization and operationalization of constituency preferences is unsuited the study of partisan primaries. Our working theory of primary representation, particularly as it relates to the “strategic positioning dilemma,” pits two constituencies within the district

against each other: the nominating constituency, which contains only nominating voters from one party, and the general election constituency, which is composed of citizens from both major parties as well as Independents. The former is theorized to prefer ideologically faithful candidates who adhere closely to the party's policy platform,⁴ while the latter prefers moderate candidates in the general election. Studies routinely acknowledge this distinction in theory, but they often abandon the distinction between the two groups applied studies, instead operationalizing the preferences of all three constituencies—the general constituency and two partisan primary constituencies—using the same single and inappropriate measure: the district-level presidential vote. The presidential vote share is not suitable for the study of primary representation for the simple reason that votes are not equivalent to policy preferences or political ideology. (I refer to “ideology” in its meaning as a summary measure of an individual's issue preferences—i.e. an “ideal point”—rather than its meaning as an abstract political value set from which policy positions can be derived.) Republican voters in a district may be ideological moderates or ideological conservatives, but the fact that they all vote Republican does not inform us on their relative ideological tastes. Similarly, a district's vote outcome captures how its constituents vote on average, but because partisans tend to vote foremost for their preferred party, this average may be more strongly affected by number of voters in each party rather than their ideological preferences. The district presidential vote fails to represent primary constituent preferences both as a concept and as a feasible proxy measure, and the U.S. representation literature's reliance on this measure for decades potentially compromises its understandings of accountability under democratized party nominations. Because we have not studied primary constituency preferences, we cannot characterize their impact in electoral representation.

The second obstacle preventing a more complete study of primary representation is the failure to incorporate primary candidates' ideal points into the analysis. Although ideal point

⁴Strategic voting complicates this characterization, which I discuss below.

ideology

simulation

estimates derived from roll-call votes such as NOMINATE are a popular tool for measuring politicians' ideological locations (Poole 2005; Poole and Rosenthal 1997), only incumbents cast roll call votes, so these measures are unavailable for non-incumbent candidates.⁵ Further, when non-incumbents enter the picture, researchers tend to focus on the positioning of general election candidates rather than primary candidates (Ansolabehere, Snyder, and Stewart 2001; Burden 2004; Canes-Wrone, Brady, and Cogan 2002). Some studies have argued that primary competition leads incumbent legislators to take non-median positions, but these studies do not observe primary candidate positions directly, instead observing the presence or threat of challengers (Brady, Han, and Pope 2007; Burden 2004). Recent advances in ideal point modeling using campaign contributions are a promising path forward (Bonica 2013, 2014; Hall and Snyder 2015), but they are not designed for the careful study of primary competition and thus contain many “post-treatment” measurement artifacts.

It must be stressed that these obstacles are not merely methodological, since the theoretical consequences are enormous. The literature's dependence on the presidential vote as a proxy for district preferences and its omission of primary candidate ideology have prevented scholars from testing basic theoretical propositions in the study of primary politics. Put simply, without serviceable measures of local partisan preferences or primary candidate positions, we can say very little about the role of primary elections in the broader democratic order of U.S. politics. This affects our knowledges of topics beyond nominations as well. To study how politicians weigh the opinions of their party's base of support against other voters in their districts, we must be able to measure the preferences of a politician's local partisan constituency.⁶ As scholars explore whose voices truly matter in shaping party platforms and

⁵Studies of candidate positioning that go beyond incumbents sometimes use survey data from challenger candidates (Ansolabehere, Snyder, and Stewart 2001; Burden 2004), but the surveys only interview general election candidates. Furthermore, the rarity of these surveys limits the generalizability of their findings over time.

⁶Clinton (2006) provides suggestive evidence on the importance of this distinction. Using a cross-sectional survey, he finds that the roll-call voting behavior of Democratic members of Congress is more responsive to the district's median constituent, while Republican members respond more strongly to the average Republican

policy (Bartels 2009; Cohen et al. 2009; Gilens 2012; Grossman and Hopkins 2016; Lax and Phillips 2012), these researchers will benefit enormously from an approach to estimate the subnational preferences of partisan voters. This dissertation will demonstrate the added value of conceptualizing voter preferences in this way.⁷

I fill this gap in the representation literature by developing a new measurement model for local partisan preferences and applying these estimates to important questions of primary representation. The model builds on the work of Tausanovitch and Warshaw (2013) and Caughey and Warshaw (2015), estimating a latent index of policy liberalism within partisan groups in Congressional districts. For each district, the model estimates the mean ideal point of Democratic and Republican constituents using survey data. With these new estimates, I directly test the hypotheses that other studies have fallen short of testing. Is it truly the case that the primary constituency is a standout cause of candidate positioning? Do primary voters nominate partisan candidates for their ideological “fit”? And do institutional configurations such as gerrymandering distort these relationships in ways commonly suggested by scholars and political observers alike?

This remainder of this chapter reviews leading theoretical approaches to primary representation, highlights the importance of partisan constituent preferences, and uses formal models to demonstrate how existing approaches fail to measure the important theoretical constructs. The chapter ends by previewing the remaining chapters of the dissertation about the new measurement model (Chapter 2) and analyses that apply the new estimates to important areas of primary representation: the strategic positioning of primary candidates (3), the vote choices of primary constituents (4), and how redistricting moderates these outcomes of interest (5).

constituent.

⁷New work by Caughey, Dunham, and Warshaw (2018) operationalizes the average ideal points of partisans within states. I offer important extensions on their modeling approach and apply the estimates to very different substantive questions.

1.1 *Limitations for inferring ideal points from votes*

This section shows the limitations of inferring voter preferences from vote shares, using notation similar to Kernell (2009).

Georgia Kernell (2009) demonstrates the difficulty of inferring district-level preferences (median voter locations) from observed votes. First, she shows that the ordering of district medians cannot be inferred from the vote shares of one election. Suppose we wish to place districts 1 and 2 on an ideological dimension. We observe that the Republican share of the two party vote in each district is p_1 and p_2 . Assuming that voter preferences are normally distributed around the median voter (equivalent to the mean voter), then vote shares can be understood as the result of the normal CDF by comparing the candidate's ideal point to the distribution of voter preferences.

$$p_i = \Phi \left(\frac{c - \mu_i}{\sigma_i} \right) \quad (1.1)$$

By inverting the normal CDF, she shows that the difference in medians μ_1 and μ_2 is not proportional to vote shares in each district, but to the z -score of the vote in each district.

$$\mu_2 - \mu_1 \propto Z(p_2) - Z(p_1), \quad (1.2)$$

The nonlinear relationship between μ_i and p_i suggests that district preferences are unidentifiable without using multiple elections resulting from the same fixed set of voter preferences μ_i .

Following a similar setup, I demonstrate that the task of inferring the positions of multiple parties is even more difficult. First, rather than assuming that voter preferences in a district are normally distributed with one mean and one dispersion term, we assume that voter preferences are mixture of two distributions (indexed 1 and 2). Each party votes for a Republican candidate akin to the normal CDF as before, but the vote share p for the Republican reflects the size of each partisan constituency in the district as well. Suppose that the size and ideal

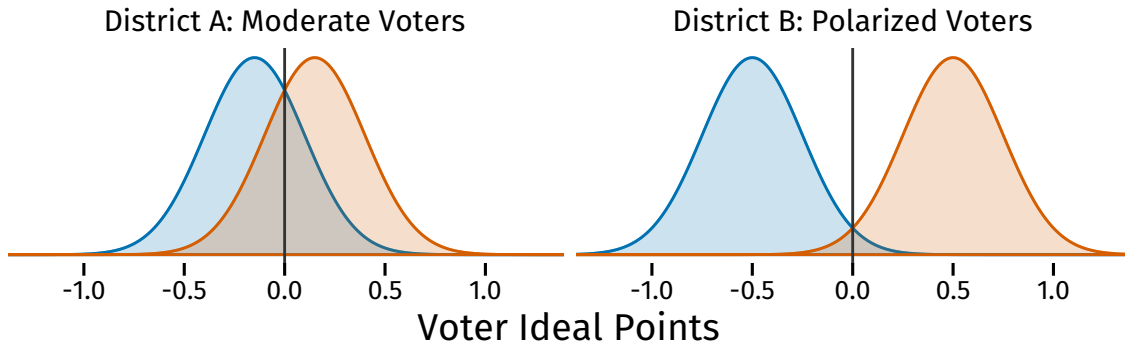


Figure 11: Two districts with identically located median voters

point of party unaffiliated is represented by a normally distributed error term ε :

$$p = \Phi\left(\frac{c - \mu_1}{\sigma_1}\right) \pi_1 + \Phi\left(\frac{c - \mu_2}{\sigma_2}\right) \pi_2 + \varepsilon, \quad (1.3)$$

where p_i reflects the proportion of the electorate that identifies with party i . Isolating μ_1 and μ_2 in this setup is rather difficult, and the choice of simplifying assumptions is limited. We could assume that the variance of preferences in each party is equal, $\sigma_1 = \sigma_2 = \sigma$, and manipulate the equation somewhat...

$$Z(p) \sigma = (c - \mu_1) \pi_1 + (c - \mu_2) \pi_2, \quad (1.4)$$

but the limitations are still significant. We could not make a simplifying assumption that $\pi_1 = \pi_2$ for but a handful of districts. We might estimate π_i from survey data

but what

1.2 Outline for the dissertation

1.2.1 Proposed Model

Value of directly modeling each party:

- identify the actual quantities of interest
- do parties “move together” or not? This is only possible to infer by modeling each party’s hierarchy separately.

Chapter Two

Modeling the Constituency's Policy Preferences

2.1 *Ideology and Spatial Models in Political Science*

Intuition of a formal model

- a voter has a preferred policy location
- they choose from the closer of two alternatives
- The “ideal point” \neq ideology
 - It’s an extra leap to talk about it as “ideology”
 - ideal point is an “operationalization” of a nebulous concept
 - so truly we are estimating the “ideal point” under an assumed model

What is the formal model intuition?

2.1.1 Latent Ideology and Item Response

Ideology itself is unobservable. It affects the way people feel about policy, but we don’t directly observe it. Explicit measures of ideological self identification are not themselves reliable because people don’t understand those items and because they aren’t great at predicting policy views either _____

TK

TK

Measurement model:

- We can't see the construct that we want, so we estimate it
- by building a model that relates the unobserved construct to observed data

2.1.2 Ability-only model

We begin with a simple model where an individual i gives a conservative response to item j if they derive more utility than they would from a liberal response. Their utility function is made up of their ideal point θ_i and idiosyncratic error ε_{ij} . We can assume that the threshold between liberal and conservative responses is at 0; this is merely a scale and location restriction on what is otherwise an unstructured ideological space.

$$y_{ij} = I(\theta_i + \varepsilon_{ij} > 0) \quad (2.1)$$

This means $y_{ij} = 1$ when the utility is positive, and $y_{ij} = 0$ otherwise.

Assuming that the idiosyncratic utility is $\varepsilon_{ij} \sim \text{Normal}(0, 1)$ gives us a probit model,

$$\Pr(y_{ij} = 1) = \Phi(\theta_i), \quad (2.2)$$

where $\Phi(\cdot)$ is the Gaussian cumulative distribution function. This assumption restricts θ such that the probability of a correct response is 50% when $\theta = 0$. The scale of θ is also restricted by the assumption that $\text{Var}[\varepsilon_{ij}] = 1$.

2.1.3 One-parameter Rasch model

Ability model assumes no “item effects”—there is no systematic variation at the item level that would lean to a correlated effect for one item across individuals.

This is the justification for the one-parameter Rasch model, developed in an educational testing framework. The model defines the probability that individual i answers item j “correctly” as a comparison between an individual i 's latent “ability” (θ_i) and a test question j 's

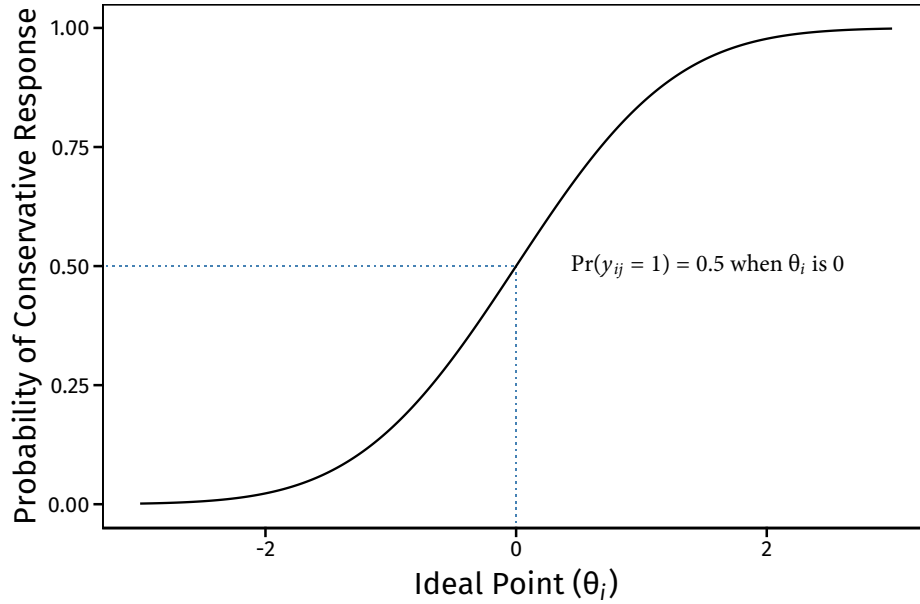


Figure 21: Ability-only model of item response

“difficulty” (κ_j). Assuming that other disturbances affecting item responses (ε_{ij}) are normally distributed, individual i ’s response to item j is

$$y_{ij} = I\left([\theta_i - \kappa_j] + \varepsilon_{ij} > 0\right), \quad (2.3)$$

which yields a probit model for a discrete outcome.

$$\Pr(y_{ij} = 1) = \Phi(\theta_i - \kappa_j) \quad (2.4)$$

Adapting this model to the context of survey response, an individual respondent i is asked to choose between two alternatives on policy item j . We let θ_i be i ’s ideal point on a liberal-conservative dimension, where larger values of θ are more conservative, and κ_j is the midpoint between the liberal and conservative policy alternatives. Respondent i is more likely to give a conservative response on policy j if their ideal point is to the “right” of the item midpoint (their ideal point is nearer to the conservative policy choice), but their response is affected by other normally distributed factors and is thus predicted only probabilistically.

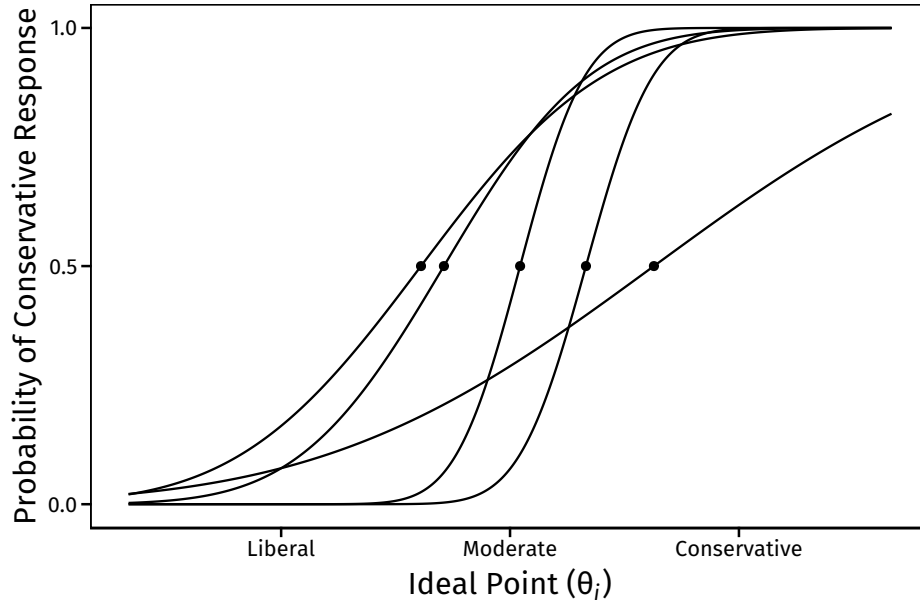


Figure 22: Examples of item characteristic curves for 5 simulated items.

2.1.4 Two-parameter Rasch Model

The item-response model makes sense only under the assumption that policy issues are choices along a single underlying dimension. The one parameter model allows non-ideological factors to affect item responses but assumes that these extraneous factors are independent across items and individuals. Policy issues don't all have the same salience to partisan and ideological debate, however, so political scientists often model policy item responses using a two-parameter model. The two-parameter model includes the additional item parameter β_j , which relaxes the assumption that all items are equally related to latent ideology. This “discrimination” parameter captures how strongly the item divides the responses of liberals and conservatives.

$$\Pr(y_{ij} = 1) = \Phi(\beta_j [\theta_i - \kappa_j]), \quad (2.5)$$

2.1.5 Applications of the IRT Approach

2.2 Modeling Party-Public Ideology in Congressional Districts

This section outlines my group-level ideal point model for party publics. It begins by describing the connection between the individual-level IRT model and the group-level model and its implication for the parameterization of the model (§ 2.2.1). I then lay out the hierarchical model for party-public ideal points in its static form (§ 2.2.2) and its dynamic form (§ 2.2.3). Lastly, I discuss more technical features of model implementation, including prior distributions and model identification (§ 2.2.4) and parameterization in Stan (§ 2.2.5).

2.2.1 Group-Level IRT Setup

To motivate the intuition of the group model, we begin the intuition of the individual and then reparameterize it.

Assume that individuals answer policy items according to their own individual ideal points. We observe a binary response from individual i to item j , which we model as a probabilistic outcome with probability π_{ij} .

$$y_{ij} \sim \text{Bernoulli}(\pi_{ij}) \quad (2.6)$$

Our model for the response probability is given by a probit model, following the utility intuition described above.

$$\pi_{ij} = \Phi(\beta_j [\theta_i - \kappa_j]) \quad (2.7)$$

Let $\sigma_j = \beta_j^{-1}$, so item discrimination is instead expressed as a “dispersion” parameter (Caughey and Warshaw 2015; Fox 2010).

$$\pi_{ij} = \Phi\left(\frac{\theta_i - \kappa_j}{\sigma_j}\right) \quad (2.8)$$

Assume that individuals are normal draws from the mean of their group, where a group is a party in a district.¹

$$\theta_i \sim \text{Normal}(\theta_{g[i]}, \sigma_{g[i]}) \quad (2.9)$$

The outcome data at the group level, rather than individual Bernoulli outcomes, are expressed as grouped Binomial outcomes Y_{gj} : the number of conservative responses in group g to item j given the total number of responses per group per item, n_{gj} . The probability that a randomly selected individual gives a conservative response (the “true conservative probability” to item j in group g) is $\bar{\pi}_{gj}$.

$$Y_{gj} = \text{Binomial}(\bar{\pi}_{gj}, n_{gj}) \quad (2.10)$$

The probability for each item-group is given a probit model from the spatial utility model.

$$\bar{\pi}_{gj} = \Phi\left(\frac{\theta_g - \kappa_j}{\sqrt{\sigma_g^2 + \sigma_j^2}}\right), \quad (2.11)$$

where σ_g is the standard deviation of ideal points within group g , which is introduced because we are now estimating the mean response within a group rather than an individual item response. Larger values of σ_g indicate more uncertainty over the item response and attenuate

tion $\bar{\pi}_{gj}$ toward 50%.²

2.2.2 Geographic Model for Group Means and Scales

les Estimates for θ_g and scales σ_g are improved using a hierarchical model.

- Using geographic data to improve estimation

¹Notation for Normal distributions will always describe the scale parameter in terms of standard deviation σ instead of variance σ^2 . This keeps the notation consistent with the way Normal distributions are expressed in Stan code.

²The binomial setup assumes that each of the n_{gj} trials is independent conditional on the mean ideal point θ_g and the item parameters κ_j and σ_j . This assumption is violated if individuals in a group answer multiple items—errors are not independent across items. I describe a design-weighting correction for this assumption in Section 2.2.5.

- Hierarchical model accounts for multiple sources of variation
- Partial pooling estimates for groups without as much data
- First, using traditional notation. Reparameterization in Section 2.2.5 greatly improves the estimation in Stan.

We consider it a draw a distribution with hypermean $\bar{\theta}_g$ and scalar standard deviation ψ_θ

$$\theta_g \sim (\bar{\theta}_g, \psi_\theta) \quad (2.12)$$

The hierarchical setup improves estimates by casting the hypermean as a conditional mean from a regression on group data. We specify this regression using geographic-level data from the districts and states where each group is located:

$$\bar{\theta}_g = \beta_{0p[g]} + X_{d[g]}\beta_{p[g]} + \alpha_{s[g]p[g]}, \quad (2.13)$$

where β_0 is a constant, X_d represents district-level data with coefficients β , and α_s represents state effects. A key feature of the hierarchical model is that the parameters are indexed by p and thus dependent on the party to which g belongs. This means there are two constants β_{0p} where $p \in \{1, 2\}$ indexes party. Group-level covariates X_g have coefficient vectors β_p that vary by party as well. We include this flexibility because geographic covariates (such as racial composition) may have different correlations with ideal points depending on the party. This is a departure from the model laid out by Caughey and Warshaw (2015), which holds the geographic regression fixed for all groups in the data.

We use a similar hierarchical regression for group scales (suppressing the g subscript which is implied by the combination of d and p).

$$\log(\sigma_g) \sim \text{Normal}(\delta_{0p} + X_d\delta_p + \eta_{sp}, \psi_\sigma), \quad (2.14)$$

where δ_{0p} represents constants for each party, δ_p is a party-specific vector of coefficients on district features, and η_{sp} are party-specific state effects.

The state effects are in turn regressions on state features.

$$\alpha_{sp} \sim \text{Normal} \left(Z_s \gamma_p + \rho_{r[s]p}, \psi_\alpha \right), \quad (2.15)$$

$$\eta_{sp} \sim \text{Normal} \left(Z_s \zeta_p + \xi_{r[s]p}, \psi_\eta \right), \quad (2.16)$$

where Z_s contains state covariates which have party-specific coefficients γ_p (for group means) or ζ_p (for group scales). Each state effect is a function of a party-specific region effect ρ_{rp} (for group means) and ξ_{rp} (for group scales) for Census regions indexed r .

2.2.3 Dynamic Model

2.2.4 Priors and Identification

2.2.5 Model Implementation in Stan

Hierarchical models often have posterior distributions whose curvature presents difficulties for sampling algorithms (Betancourt and Girolami 2015; Papaspiliopoulos, Roberts, and Sköld 2007). To improve the estimation in Stan, I parameterize the hierarchical models in the “non-centered” rather than the “centered” form. Whereas the centered form considers θ_g as a random draw from a distribution, the non-centered parameterization considers θ_g as a function of the hypermean and a random error.

$$\theta_g = \beta_{0p} + X_g \beta_p + \alpha_{s[g]} + z_g \epsilon \quad (2.17)$$

where $z_g \epsilon$ represents a group-level error term. It is composed of a z -score that is Normal $(0, 1)$ and a scale parameter ϵ . The non-centered parameterization has the same algebraic behavior as the centered parameterization, but it has the practical effect of improving Monte Carlo sampling by de-correlating the parameters in the hierarchical model. We can also de-center the $\alpha_{s[g]}$ term

$$\alpha_{s[g]p} = Z_{s[g]} \gamma_p + u_{sp} \tau \quad (2.18)$$

where u_{sp} is a z -score distributed Normal $(0, 1)$, and τ is a scale factor.

We also have a hierarchical model that predicts the ideal point standard deviation within each group, σ_g . This makes the model “heteroskedastic”—we are modeling the mean ideal point within each group and the variance, conditional on hierarchical covariates. The model for σ_g in non-centered form is as follows:

$$\log(\sigma_g) = X_g \delta_p + Z_{s[g]} \eta_p + m_g \nu + m_{sp} \lambda \quad (2.19)$$

Where X_g and Z_{sp} are the same group- and state-level covariates as the above regression, δ_p and η_p are party-varying coefficients. The terms $m_g \nu$ and $m_{sp} \lambda$ are “factored” error terms for groups and states, where m_g and m_{sp} are each distributed Normal $(0, 1)$, while ν and λ are scale factors.

Factoring

IRT Model

Noncentered Hierarchical Model

Any other vector/matrix tricks?

Read stan files into an appendix?

2.3 Simulation and Model Validation

Doing a non-centered parameterization

Chapter Three

Candidate Positioning in Primary Elections

U.S. House primary data from Pettigrew, Owen, and Wanless (2016).

3.1 Causality

DAGs

Controlled direct effect (ideology, holding fixed the vote in the district)

Chapter Four

The Constituency Decides: Preferences over Ideological Alternatives

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Chapter Five

Redistricting and Ideological Representation

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Appendix A

Group IRT Model

Appendix B

Colophon

This document was produced using R, R Markdown, \LaTeX . The document was built using the bookdown package for R. The document template is a variation on TJ Mahr's buckydown template, which was itself an adaptation of documents designed by and for students at the Universities of Washington and Wisconsin. The PDF is typeset using pdf \TeX . The body text is *MinionPro-LF* in 12pt size.

The data and source code for this dissertation have been organized into an online Git repository on Bitbucket. A hard copy of the thesis can be found in the University of Wisconsin library system.

- Git repository: <https://bitbucket.org/mikede Crescenzo/dissertation>
- huskydown: <https://github.com/benmarwick/huskydown>
- bookdown: <https://github.com/rstudio/bookdown>

This version of the thesis was generated on 2019-08-16 16:51:27. The repository is currently at this commit:

```
## Commit: 24c34b88dd31da3497d9fec5de6b33feb5f6c97f
## Author: Michael DeCrescenzo <mgdecrescenzo@gmail.com>
## When: 2019-08-13 19:01:29
##
```

```
##      baby changes for simulated data
##
## 2 files changed, 9 insertions, 11 deletions
## code/02-dgirt/22-sim/long-data-sim.R | -11 +8  in 3 hunks
## code/sscc/ssc-run.sh                  | - 0 +1  in 1 hunk
```

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