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ORIGINAL ARTICLE

The electoral implications of politically irrelevant cues under demanding electoral systems

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Abstract
Cognitively demanding electoral systems increase the chance that voters make their choices based on politically irrelevant cues. To illustrate this argument, I analyze the effect of candidate name complexity—a visual cue that contains no politically meaningful information—in Japan, where voters need to write their preferred candidate's name on a blank ballot paper. I find that when electoral systems require voters to weigh a large number of candidates and simultaneously reduce the usefulness of partisan cues, candidates with more complex names tend to receive lower vote shares. By contrast, under less cognitively demanding systems, candidate name complexity has no effect on election outcomes. These findings have important implications for the debate on the "best" electoral system design.

Keywords: Comparative politics; political institutions; representation and electoralsystems; voting behavior

Seemingly subtle cues that voters find at polling stations can have an unintended impact on election outcomes (Niemi and Herrnson, 2003; Reynolds and Steenbergen, 2006). For example, ballot order (Ho and Imai, 2008), ballot color (Garrett and Brooks, 1987), ballot orientation (Calvo *et al.*, 2009), and other minor information on ballot papers (e.g., candidate faces, party logos; Schaffner *et al.*, 2001; Moehler and Conroy-Krutz, 2016) introduce some biases in the ways in which voters evaluate candidates. Crucially, some of these factors are politically irrelevant because they provide no information about the policy, performance, or competence of candidates. As a result, this kind of cue-taking behavior may undermine the core assumption of representative democracy that voters select their representatives based on policy and performance (Achen and Bartels, 2016).[1]

Under what conditions are voters more likely to engage in this kind of behavior? This study explores how the interplay between electoral systems and the information environment makes voters more vulnerable to the influence of politically irrelevant cues at the polling station. Understanding the role of electoral rules is important because some electoral rules create cognitively demanding information environments that make it more difficult for voters to sort out irrelevant information and make fully optimal decisions (O'Reilly, 1980; Eppler and Mengis, 2004). I hypothesize that cognitively demanding systems, which force voters to go over a large set of options and to perform complicated decision-making tasks, increase the chance that those voters use easily accessible but politically irrelevant cues before casting their votes.

To test this proposition, I examine the electoral effect of candidate name complexity in the Lower House elections in Japan. The visual complexity of a candidate name is a politically irrelevant cue because it is arguably orthogonal to the candidate's past performance, policy position, or

[1]For a related debate about how politically irrelevant events, such as weather and sports events, affect voter behavior, see Achen and Bartels (2016), Gasper and Reeves (2011), and Healy *et al.* (2010).

personal quality. Nevertheless, some psychological studies suggest that this kind of visual stimulus associated with names can have an unintended impact on people's evaluation of others (O'Sullivan *et al.*, 1988; Silva *et al.*, 2017; Zürn and Topolinski, 2017; Fukumoto and Miwa, 2018). Because Japan uses a write-in ballot that requires voters to write their preferred candidate's name on a blank paper, a minor cue such as name complexity could distort voters' decisions under certain circumstances.

The Lower House elections in Japan offer an interesting institutional setting because two electoral rules that have been used there—a single nontransferable vote system (SNTV) until 1993 and a single member district plurality system (SMDP) since 1996—show important variation in their cognitive demands. Due to relatively large district magnitude (i.e., the number of legislative seats in a district), the number of candidates per district tends to be larger under SNTV than SMDP, and the former system requires voters to process more information. Further, the presence of intraparty competition under SNTV aggravates cognitive demands by depriving voters of the ability to use party labels as a voting cue. As a result, SNTV poses higher cognitive burdens on voters' capacity to assess candidates than SMDP, potentially making them more susceptible to the impact of politically meaningless name cues. A consequence is that, under SNTV, candidates with simpler names (e.g., 山口一人 and 小川りの) may enjoy an electoral advantage over those with more complex names (e.g., 纐纈蓮磨 and 瀧澤麗覇).[2]

I find that candidates with simpler names enjoy up to 2 percentage point higher vote shares than those with more complex names under SNTV, and this effect is large enough to change election results in more than one-fourth of the districts. By contrast, I fail to find the association between name complexity and vote share under SMDP. Further, within SNTV, the negative effect of visual name complexity is mainly driven by districts with a relatively large number of candidates (≥ 6). Hence, in SNTV districts that resemble SMDP districts in terms of their cognitive demands (as captured by the number of candidates), the effect of name complexity is not statistically different from zero. Together, these findings suggest that the cognitive demands of electoral systems may condition the extent to which politically irrelevant cues influence vote choice.

This study has broad implications for the debate on electoral engineering (Powell, 2000; Shugart and Wattenberg, 2001; Crisp and Ingall, 2002; Golder and Stramski, 2010; Carey and Hix, 2011; Lijphart, 2012). Although there is extensive discussion about how to design electoral systems to achieve better representation, little attention has been paid to the same question from the perspective of electoral systems and cognitive demands. My findings suggest that electoral engineers need to think more carefully about how electoral rules condition the information environment of elections, thereby imposing constraints on voters' abilities to make optimal decisions. Since voters are not always politically sophisticated nor do they show a high level of political interest, we cannot assume that they make reasonable choices under every circumstance. To help them make better decisions, it may be better to use electoral systems that minimize the cognitive demands of vote choice.

1. Electoral systems and cognitive demands

The role of the information environment in shaping voter behavior is well established. The availability of information enhances political learning (Jerit *et al.*, 2006). Information-rich environments allow voters to correctly identify the positions of parties (Banducci *et al.*, 2017) and engage in elections more actively (Hayes and Lawless, 2015). Detailed information about individual candidates also enables voters to make their decisions without relying on partisan cues (Peterson, 2017). Further, a rich information environment improves voters' monitoring capacity and politicians' responsiveness (Snyder and Strömberg, 2010).

[2]All Japanese letters occupy the square space with the same height and width, but those used in the latter names look far denser and more complex than those in the former (Liversedge *et al.*, 2014).

However, the role of the information environment is not always positive. Some studies from political psychology suggest that the provision of too much information about candidates and parties quickly leads to information overload (Lau and Redlawsk, 2006; Lau *et al.*, 2008; Rogers and Tyszler, 2018). Excessive information also complicates decision-making environments, inducing confusion and choice fatigue among voters (Augenblick and Nicholson, 2015). Consistent with these concerns, Cunow (2014) provides experimental evidence that increasing the number of candidates on the ballot substantially reduces voters' intention to vote in elections. Augenblick and Nicholson (2015) also show that a large number of choice sets reinforce voters' tendency to abstain or simply vote for the status quo. In short, some information environments may constrain voters' behavior.

Importantly, electoral systems play a critical role in shaping the information environment of vote choice. Here, particularly important are two aspects of electoral rules: (1) district magnitude and (2) the distinction between candidate- and party-centric systems. First, district magnitude determines the number of candidates and parties competing in the district. As district magnitude increases, the number of choices also increases. Since voters have a limited cognitive capacity to discern among a large set of alternatives, larger district magnitude makes information processing more costly and challenging (Carey and Hix, 2011; Taagepera *et al.*, 2014). Therefore, other things equal, district magnitude is positively associated with the cognitive demands of elections.

However, how much district magnitude intensifies cognitive demands depends on the second dimension of electoral rules: candidate- versus party-centric systems (Carey and Shugart, 1995; Shugart *et al.*, 2005).[3] Some candidate-centric systems introduce intraparty competition. The presence of several candidates from the same party in the district minimizes the usefulness of partisan cues and forces voters to gather detailed candidate-level information (McCubbins and Rosenbluth, 1995). By contrast, party-centric systems allow voters to make their choices based simply on party-level factors. To the extent that candidate-centric systems make information processing more cumbersome than party-centric systems, the former impose greater cognitive demands on voters for a given magnitude than the latter (Shugart *et al.*, 2005).

These two features of electoral rules allow us to map different systems by their cognitive demand. First, a SMDP is least informationally demanding. Under SMDP, district magnitude is by definition one, which suppresses the number of options that voters need to consider. SMDP also enables voters to use party labels as a meaningful information shortcut. By contrast, candidate-centered systems with intraparty competition, such as the SNTV and open-list proportional representation (PR) systems, have higher cognitive demands. Under these systems, information environments become far more cognitively demanding as district magnitude increases. Finally, under party-centric closed-list PR systems, cognitive demands are still an increasing function of district magnitude. However, the positive effect of district magnitude on cognitive demands under these systems is less acute than under candidate-centric systems because decision-making tasks are less complicated.

Cognitively demanding electoral rules change voter behavior in many different ways. For example, Taagepera *et al.* (2014) argue that as district magnitude and the number of candidates increase, voters overwhelmed with too much information are more likely to retreat from the electoral process. Hence, there should be a negative association between district magnitude and turnout once district magnitude becomes sufficiently large. Alternatively, voters under demanding systems may try to make the best possible choices by looking for information shortcuts that allow them to simplify their decision rules. Consistent with this argument, Shugart *et al.* (2005) show that under open-list PR systems with large district magnitude, voters utilize

[3]The extent to which electoral rules are candidate-centric is determined by three factors: (1) ballot control (the degree to which party leaders control access to party ballot); (2) vote pooling (levels at which votes are pooled); and (3) the number and type of votes that voters have (Carey and Shugart, 1995).

the localism of a candidate as a heuristic (Jankowski, 2016). Marcinkiewicz and Stegmaier (2015) also find that when electoral rules become more demanding, voters are more likely to rely on ballot position cues provided by parties.[4]

However, these accounts may not necessarily explain the behavior of every voter under cognitively demanding systems. In fact, there are also voters who continue to participate but fail to acquire appropriate information shortcuts (Cunow, 2014). Given the presence of these voters, what is not explicitly considered in the prior studies is that cognitively demanding rules can also limit voters' abilities to make informed decisions. This situation may happen because highly demanding information environments make it more challenging for people to correctly set their priorities and recall prior information (Keller and Staelin, 1987; Eppler and Mengis, 2004). By so doing, demanding environments restrict people's abilities to filter irrelevant information, which inevitably leads to suboptimal choices (O'Reilly, 1980).

The primary implication of this argument is that when electoral systems generate more cognitively challenging electoral environments, voters' decisions may become more susceptible to the influence of politically irrelevant cues. Confused with a complicated set of options, some voters may find it more difficult to make appropriate judgments about the policy and performance of candidates. Under this circumstance, some of the voters may, perhaps even inadvertently, rely on seemingly minor cues that they easily find at the polling station without regard for their relevance to candidates' quality.[5]

2. Candidate name complexity as an irrelevant cue

Prior studies on voters' cue-taking behavior at the polling station identify a range of subtle cues that they mistakenly use, including order, color, and other minor information displayed on a ballot paper (Niemi and Herrnson, 2003; Reynolds and Steenbergen, 2006; Moehler and Conroy-Krutz, 2016). Although what kind of politically irrelevant information shapes voters' decisions may vary from context to context, the setting of Japanese elections makes the visual complexity of candidate names a particularly interesting example.

In Japan, voters are exposed to a relatively limited number of "last-minute" cues. Inside the polling booth, the voters are provided with the names and party affiliations of candidates but have no access to other information, such as candidates' faces or policy positions. Given the type of information available to voters right before casting their votes, it is reasonable to expect that some of them become highly reactive to name-related cues (Fukumoto and Miwa, 2018). Importantly, while names may contain politically useful cues, such as class, gender, and ethnicity, they also carry politically meaningless information, such as their smoothness and complexity. Some studies show that the latter type of name cue can have an unintended effect on voters' perceptions about the attractiveness of candidates (O'Sullivan *et al.*, 1988).

Moreover, an interesting feature of Japanese elections is the use of a write-in ballot, which obliges voters to write the name of their favored candidate on a blank paper. Requiring an act beyond simply checking a box on the ballot, write-in ballots increase the costs of voting considerably (Fujiwara, 2015).[6] This fact is particularly true in Japan because of difficulty in remembering and writing *kanji* (Chinese characters). Unlike alphabets, there are more than several thousand different *kanji*, and people do not remember all of them. In addition, some *kanji* are very complex and difficult to write. It is common for Japanese people, even well-educated

[4]Other studies also show that under different electoral systems, voters use different types of information (Rudolph and Däubler, 2016; Blumenau *et al.*, 2017).

[5]These voters may be akin to what Gasper and Reeves (2011) call the "responsive electorate," which readily makes the retrospective evaluation of the government as a direct response to the absolute state of the world without regard to the responsibility of the incumbent.

[6]Fujiwara (2015) shows that abolishing a write-in ballot in Brazil has led to the *de facto* enfranchisement of less educated people by reducing the chance that their votes are invalidated due to writing errors.

individuals, to make writing mistakes. Given these features, write-in ballots may increase the possibility that voters take into consideration the cues that are associated with complex names, even if they are politically irrelevant.

There are at least two ways in which candidate name complexity could affect vote choice. The first mechanism is related to the psychological effect of visual stimuli on people's cognition (Donderi, 2006; Eng *et al.*, 2005). A number of psychological studies suggest that simpler images require less processing capacity and are more easily stored in short-term memory than more complex images. Accordingly, visually complex objects, such as ads, brand logos, and even names, have a negative impact on people's attention and affection (Pieters *et al.*, 2010; Van Grinsven and Das, 2016; Silva *et al.*, 2017). This kind of psychological effect may well extend to the ways in which Japanese voters approach candidate names at the polling booth.

In particular, when they enter a voting booth, some voters' attention may immediately go to candidates with simpler names. Further, such attention may be translated into some sorts of positive feelings about candidates, as commonly observed in the ways in which people perceive others with simpler names in non-electoral contexts (Silva *et al.*, 2017; Zürn and Topolinski, 2017).[7] Not surprisingly, the cumbersome tasks of writing a candidate name should reinforce this tendency. The fact that some *kanji* are difficult to recognize and reproduce may provide an additional psychological reason to like simpler names that are easier to write. As a result, candidates with simpler names may take some votes away from those with more complex names.[8]

The second mechanism is related to the error-prone nature of write-in ballots. Since they require voters to accurately write the name of a candidate, some votes may be invalidated (not counted) in a systematic manner (Fujiwara, 2015). In the context of Japanese elections, to the extent that more complicated *kanji* induce more writing errors, votes cast for candidates with more complex names may be more likely to be invalidated.[9] Hence, more complex names may be associated with a higher rate of wastage, especially when the information environment prevents overloaded voters from carefully reflecting on their choices.

The argument in the previous section suggests that in order to comprehend the impact of candidate name complexity, it is important to take into account how electoral systems moderate the cognitive demands of vote choice. Until 1993, the Lower House elections in Japan used SNTV, under which voters cast one vote in the multimember district.[10] District magnitude varied from 1 to 6, and the average number of candidates in the district was 7.2. Further, multiple candidates from the same party competed with each other. Intraparty competition necessitated that voters looked beyond party labels, which led to the extensive personalization of electoral campaigns (McCubbins and Rosenbluth, 1995).

By contrast, under SMDP, which has been used since 1996, district magnitude is by definition always set equal to 1. The average number of candidates per district is 3.8, substantially lower than the number under SNTV. Moreover, since every district has only one seat, there is no intraparty competition. As a result, voters can generally rely on partisan cues to make their voting decisions, and electoral campaigns become more party-centric (Hirano, 2006; Catalinac, 2016).

What is important here is that the cognitive demands of vote choice are far more extensive under SNTV than under SMDP. Because of larger district magnitude and the presence of

[7]For instance, simple names may increase trustworthiness.

[8]This mechanism implies that some voters go to the polling station without a solid idea about whom to vote for or change their choices when they see a complicated set of options. These kinds of undecided voters are common elsewhere, including Japan (Otokita, 2017). Moreover, the impact of this kind of "last-minute" cue is well established (e.g., Ho and Imai, 2008; Moehler and Conroy-Krutz, 2016).

[9]In reality, small mistakes are unlikely to result in invalidation as long as those who count the votes can identify voters' choices. My assumption is that the probability that voters make major errors increases as candidate names become more complex.

[10]Under SNTV, there is no vote pooling at the party level.

intraparty competition, SNTV provides a more complicated set of options than SMDP, requiring voters not only to process more information but also to go over many different strategic scenarios (McCubbins and Rosenbluth, 1995; Horiuchi, 2005). This cognitive difficulty may increase the chance that voters have difficulty in making fully optimal decisions. As a result, they may be more likely to make poorly informed choices, unintentionally resorting to the visual complexity of candidate names. A consequence is that candidates with simpler names may enjoy an electoral advantage over those with more complex names under SNTV, but not necessarily under SMDP.

3. Empirical analysis

To measure candidate name complexity, I use the total number of strokes in the candidate name. It is an appropriate measure because the visual complexity of *kanji* increases as a function of the number of strokes (Liversedge *et al.*, 2014). At a glance, letters with a larger number of strokes look more difficult to write than those with a smaller number of strokes. Further, *kanji* with a larger number of strokes are less commonly used in daily life. As a result, some voters may subconsciously avoid candidates whose names consist of complex *kanji* or make writing mistakes when they try to reproduce these names.

For illustration, I show how to calculate the name complexity of two prominent politicians, Shinzo Abe (prime minister as of 2019) and Yukio Hatoyama (prime minister in 2009–2010). In Japanese, Shinzo Abe is written as 安倍晋三. Since the number of strokes in each letter is 安 = 6, 倍 = 10, 晋 = 10, and 三 = 3, his name complexity score is 6+10+10+3=29.[11] In the case of Yukio Hatoyama (鳩山由紀夫), the number of strokes in each letter is 鳩 = 13, 山 = 3, 由 = 5, 紀 = 9, and 夫 = 4. Therefore, his name complexity score is 13+3+5+9+4=34. Yukio Hatoyama receives a higher complexity score than Shinzo Abe.

I rely on the Reed–Smith Japanese House of Representatives Elections Data Set (JHRED; Reed and Smith, 2017) to measure candidate name complexity. Observations include all candidates in the general elections of the Lower House between 1947 and 2014. Among unique candidates, the median name complexity score is 30, the minimum is 7, and the maximum is 72. Politicians with very low name complexity include Tsutomu Kawara (瓦力), Hisa Yoneyama (米山久), or Koichi Yamaguchi (山口好一). By contrast, legislators with very high name complexity are Kanjyu Sato (佐藤観樹), Fukushiro Nukaga (額賀福志郎), or Naomi Tokashiki (渡嘉敷奈緒美). Recognize that the names in the latter group are visually denser and more complex than those in the former.

The key assumption is that the number of strokes contains no politically useful information. Since many different combinations of letters result in the same number of strokes by chance, the number of strokes does not inform the past performance of politicians nor predict the type and competence of candidates. Similarly, it would be surprising if an increase or decrease in the number of strokes led to systematic changes in the policy stances or personal quality of candidates.[12] Therefore, it is hard to believe that voters use name complexity as a policy- or performance-related cue when making voting decisions.

One caveat of the current approach is that candidate names in the JHRED are based on their actual names, but they may not always be the same names that voters saw at the polling station. This discrepancy can happen because there are several ways to simplify written names in Japanese. For example, one can write the name of Shinzo Abe as あべしんぞう instead of 安倍晋三, and the former looks simpler (has a lower number of strokes) than the latter. It is known that when running for office, some candidates deliberately use the simplified versions of their names to help voters remember their names (Smith, 2018). The strategic manipulations of registered names can lead to changes in name complexity scores and measurement errors.

[11]Note that the number of strokes is not always equal to the number of straight lines.

[12]In section A of the appendix, I show that name complexity is not a significant predictor of ideologies nor campaign strategies using data provided by Catalinac (2016, 2018).

Although this issue should be seen as a limitation of the study, three points deserve emphasis. First, if I use names that voters saw at the polling station, estimating the unbiased effects of name complexity becomes more difficult. We do not know what explains candidates' decisions to change their registered names, and candidates who simplified their names may be systematically different from those who did not in both observed and unobserved ways.[13] This increases a concern about omitted variable bias. By contrast, using candidates' actual names, I may alleviate this problem. Since their actual names were "exogenously" determined at birth in most cases, the assumption about no confounder may become more plausible (section A of the appendix). Given the reliance on actual names, the estimates of name complexity in this study can be interpreted as intention-to-treat effects (e.g., Angrist, 2006).[14] This approach only produces conservative estimates of name complexity by biasing them toward zero.

Second, for a random sample of candidates, I check how often they simplified their registered names. Comparing names presented in the JHRED and campaign manifestos that they made, I find that a fairly large number of candidates did not simplify their names. Moreover, even when they did, the correlation in name complexity scores between actual and registered names remains fairly high (section B of the appendix). Finally, I also reanalyze the main results below using an alternative measure—which I call name difficulty scores—that only moderately correlates with name complexity scores. In this way, I demonstrate that the main findings are robust to the presence of some measurement errors (section E of the appendix).

Turning to the model specification, I rely on a multilevel linear model. Formally:

$$\begin{aligned}\text{Vote Share}_{ct} = {} & \alpha + \beta_1 \text{Name Complexity}_c + \beta_2 \text{Name Length}_c \\ & + \gamma_1 \text{Number of Candidates}_d + \gamma_2 \text{District Magnitude}_d \\ & + \nu_c + \nu_p + \delta_t + \epsilon_{ct}\end{aligned} \tag{1}$$

where, the outcome is the vote share (0–100 scale) of candidate c in election-year t (belonging to party p and running in election-district d). α is a common intercept, and β_1 is a coefficient on name complexity. I also control for name length to account for the fact that the additive index of name complexity makes longer names more likely to have higher complexity scores.[15] Further, since the vote share of the candidate is mechanically affected by the number of candidates and district magnitude, I control for these two variables.[16] The number of candidates is log-transformed because it is right skewed. Then, ν_c and ν_p are random effects by candidate and party, respectively. I assume $\nu_c \sim \mathcal{N}(0, \sigma_c^2)$ and $\nu_p \sim \mathcal{N}(0, \sigma_p^2)$. Finally, δ_t is election-year fixed effects that account for time difference, and ϵ_{ct} denotes an idiosyncratic error term. I fit the parameters of the above model with Hamiltonian Monte Carlo implemented in Stan with weakly informative Gaussian priors for the regression coefficients.[17]

I estimate models for the SNTV and SMDP observations separately. The rationale for this is that since the observations of this study come from a relatively large time period, empirical models need to control for the differences in the electorate or electoral environments that existed across time. For example, during the period under study, there were gradual changes in education

[13] For example, the savviness of candidates, which is unmeasurable, may be correlated with both the decision to simplify their names and their electoral success.

[14] Put differently, actual names can be seen as an instrument for registered names that voters saw, and I estimate a reduced form regression of vote share on this instrument.

[15] In other words, name length may be a confounder of the relationship between name complexity and vote share. This variable takes the value of 4 for Abe Shinzo (安倍晋三) and the value of 5 for Yukio Hatoyama (鳩山由紀夫). The correlation between name complexity and name length is 0.40.

[16] In models with the SMDP observations, district magnitude is not included because it is always equal to 1.

[17] I use three MCMC chains, each drawing 2,000 samples after discarding 1,000 warmup samples, leaving me with a total of 6,000 usable samples. I assess convergence based on Gelman–Rubin $\widehat{R}$ statistics, which indicate apparent convergence.

levels among voters. The characteristics of voters who cast their votes also varied across years due to changes in the levels of turnout. Further, media environments changed over time. If I pool the SNTV and SMDP observations and include an indicator of the electoral rules, I cannot control for these time-varying factors that may affect voters' cue-taking behavior because the electoral reform in Japan happened at one point in time. By contrast, analyzing the SNTV and SMDP observations separately, I can include election-year fixed effects δ_t. By eliminating any time difference that existed under the same rule, this approach yields conservative estimates of name complexity.[18]

3.1. Main findings

Table 1 shows the results of models with the SNTV observations. Model 1 is estimated without candidate random effects. The posterior mean of the coefficient on name complexity is −0.027 with a 95 percent credible interval of [−0.037, −0.017]. In model 2, I include candidate random effects. The posterior mean of name complexity is −0.031, which is again statistically reliable with a 95 percent credible interval of [−0.046, −0.015]. Therefore, under SNTV, candidates with more complex names tend to receive lower vote shares than those with simpler names.

The effect size of name complexity is substantial. The median difference in name complexity scores among candidates in the same district is 23. According to model 2, an increase of 23 in stroke count accounts for a 0.71 percentage point decrease in vote share. Since the margin of victory under SNTV is very small (e.g., median 1.36 percentage points), the median increase/decrease in name complexity can change the winners of the election in 30 percent of the districts. Further, the maximum difference in name complexity scores among candidates in the same district is 58. This difference leads to a 1.79 percentage point decrease in vote share, which is large enough to change the winners in 58 percent of the districts.

In models 3 and 4, I test the effect of an alternative measure of name complexity. I use average letter complexity, or the average number of strokes in the name letters (i.e., name complexity score divided by name length). Model 3 does not include candidate random effects, whereas model 4 does. In both models, the posterior distributions of the coefficient on average letter complexity point to a statistically reliable negative effect, with 95 percent credible intervals of [−0.151, −0.073] and [−0.190, −0.065], respectively. Therefore, regardless of whether I use the total or average number of strokes, the results do not change.

In models 5 and 6 of Table 1, I reestimate models 1 and 3 including only candidates running for office for the first time.[19] The rationale of this exercise is that because voters have relatively little information about first-time candidates, those who are confused with informational demands may be even more likely to rely on politically irrelevant cues. As a result, the negative impact of name complexity on vote share may be larger among first-time candidates. In models 5 and 6, the posterior means of the coefficients on name complexity and average letter complexity are −0.039 and −0.153, respectively (95 percent credible intervals [−0.056, −0.022] and [−0.216, −0.091]). Comparing the posterior means in models 1 and 5, the negative effect of name complexity is greater in the latter. Model 5 suggests that name complexity can explain up to a 2.26 percentage point decrease in vote share. Importantly, models 5 and 6 also suggest that the statistically reliable findings of models 1–4 are not necessarily the artifact of a relatively large sample size. Even when a subset of the observations is used, candidate name complexity continues to show a negative and statistically reliable effect on vote share.

[18]Of course, this approach does not necessarily eliminate time difference across the two systems. However, based on previous studies on the electoral reform in Japan (Horiuchi and Saito, 2003; Krauss and Pekkanen, 2004; Hirano, 2006; Catalinac, 2016; Smith, 2018), it is fair to assume that there was no abrupt change in voter behavior or electoral environments that co-occurred with the 1994 electoral reform (other than those explained by the reform itself).

[19]Since candidate c enters the data only once, candidate random effects cannot be included.

Table 1. The effect of name complexity on vote share under SNTV

	Vote share					
	(1) All	(2) All	(3) All	(4) All	(5) First-time candidates	(6) First-time candidates
Name complexity	− 0.027	− 0.031			− 0.039	
	(0.005)	(0.008)			(0.009)	
Name length	0.320	0.349			0.353	
	(0.068)	(0.106)			(0.114)	
Average letter complexity			− 0.112	− 0.125		− 0.153
			(0.020)	(0.032)		(0.032)
Number of candidates (log)	− 7.721	− 7.031	− 7.724	− 7.044	− 5.723	− 5.724
	(0.186)	(0.161)	(0.179)	(0.154)	(0.288)	(0.278)
District magnitude	− 1.176	− 0.823	− 1.176	− 0.818	− 0.584	− 0.579
	(0.057)	(0.071)	(0.056)	(0.070)	(0.092)	(0.091)
σ_c	−−	4.048	−−	4.050	−−	−−
σ_p	4.394	4.078	4.381	4.072	3.885	3.885
Election-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N	17,998	17,998	17,998	17,998	5,993	5,993

Note: The outcome is the vote share of the candidate. Models 1–4 use all observations under SNTV, while models 5 and 6 only use first-time runners. Average letter complexity = name complexity/name length. Standard deviations of the parameter posteriors are in parentheses.

In Table 2, I turn to the results of the models with the SMDP observations. Models 1–6 correspond to those in Table 1. Models 1 and 2 test the effect of name complexity without and with candidate random effects. Models 3 and 4 test the effect of average letter complexity without and with candidate random effects. Finally, models 5 and 6 are the same as models 1 and 3 except that they only include the first-time candidates. Unlike the results of the SNTV models, I fail to find the negative effect of name complexity on vote shares under SMDP. The posterior means of name complexity and average letter complexity never show a statistically reliable effect, some of which are even signed incorrectly.[20] Further, comparing the results of Tables 1 and 2, the posterior estimates of name complexity under SNTV are smaller than those under SMDP at the 95 percent level.

In summary, the results suggest that candidates with more complex names tend to be disadvantaged under SNTV, but not necessarily so under SMDP.[21] These findings are consistent with the argument that cognitively demanding electoral systems may increase the chance that voters' decisions are inadvertently affected by politically meaningless information. Regardless, any observational study like this must show more than a correlation between the key variables to make a stronger case. In the following subsections, I take several steps to validate my argument.

3.2. Mechanism

I argued that candidate name complexity can shape voter behavior and election outcomes in two different ways: (1) inattentive voters are attracted to a candidate whose name is less visually complex and easier to write and (2) votes cast for candidates with complex names are more likely to be invalidated due to major writing errors. Although the first mechanism cannot be assessed with observational data, the second one is indirectly testable using data on invalid votes at the district level. If the second mechanism partly explains the above findings, district-level name complexity

[20]The 95 percent credible intervals of models 1–6 are [− 0.10, 0.049], [− 0.014, 0.057], [− 0.068, 0.148], [− 0.089, 0.179], [− 0.040, 0.034], and [− 0.154, 0.115], respectively.

[21]In section D of the appendix, I show that the results are robust to the use of district-year fixed effects. In section F of the appendix, I suggest that some alternative explanations are not plausible.

Table 2. The effect of name complexity on vote share under SMDP

	Vote share					
	(1)	(2)	(3)	(4)	(5)	(6)
	All	All	All	All	First-time candidates	First-time candidates
Name complexity	0.019	0.021			− 0.003	
	(0.015)	(0.018)			(0.018)	
Name length	0.216	0.254			0.350	
	(0.203)	(0.249)			(0.248)	
Average letter complexity			0.039	0.043		− 0.020
			(0.056)	(0.068)		(0.070)
Number of candidates (log)	− 19.215	− 16.663	− 19.203	− 16.648	− 11.873	− 11.868
	(0.505)	(0.454)	(0.492)	(0.455)	(0.600)	(0.601)
σ_c	−−	6.372	−−	6.376	−−	−−
σ_p	11.746	10.723	11.761	10.73	12.541	12.492
Election-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N	7,867	7,867	7,867	7,867	3,250	3,250

Note: The outcome is the vote share of the candidate. Models 1–4 use all observations under SMDP, while models 5 and 6 only use first-time runners. Average letter complexity = name complexity/name length. Standard deviations of the parameter posteriors are in parentheses.

should be positively associated with the proportion of invalid (uncounted) votes under SNTV, but not under SMDP.

To test this proposition, I estimate the following multilevel linear model:

$$\begin{aligned}\text{Invalid Votes}_{\text{dt}} =& \alpha + \beta_1 \text{Average Name Complexity}_{\text{dt}} \\ & + \beta_2 \text{Number of Candidates}_{\text{dt}} + \beta_3 \text{District Magnitude}_{\text{dt}} \\ & + \nu_{\text{d}} + \delta_{\text{t}} + \epsilon_{\text{dt}}\end{aligned} \tag{2}$$

where the unit of analysis is the election-district (district *d* in year *t*), and the outcome variable is the logged proportion of invalid votes. I log-transform this variable because it is heavily right skewed. β_1 is a coefficient on average name complexity, or the mean name complexity score of the candidates running in the same district. The higher this value is, the larger the number of candidates with complex names in the district. I also control for the logged number of candidates and district magnitude as before. ν_d indicates random effects by district with $\nu_{\text{d}} \sim \mathcal{N}(0, \sigma_{\text{d}}^2)$. Further, δ_t denotes election-year fixed effects, which account for unobserved variation in voter behavior and other factors across years. Finally, ϵ_{dt} is an idiosyncratic error term. Due to data availability, the analysis is based on the Lower House elections between 1958 and 2014.[22] I again model the SNTV and SMDP observations separately.

Figure 1 summarizes the posterior means and 95 percent credible intervals of the coefficients on average name complexity.[23] The first row shows the result of the SNTV model. The effect of average name complexity is positive and reliable with a 95 percent credible interval of [0.0004, 0.0104]. The coefficient estimate is 0.005, meaning that a one unit increase in average name complexity leads to a 0.5 percent increase in the proportion of invalid votes. Therefore, under SNTV, more votes are discarded in districts with a larger number of candidates with complex names. By contrast, the second row indicates that under SMDP, the effect of average name complexity is not statistically discernible from 0, with a 95 percent credible interval of [− 0.005, 0.002]. The null result is consistent with the findings of the previous exercises. In short, the analysis of

[22]Data on invalid votes come from the JED-M (Mori and Mizusaki, 2012).

[23]The full models are summarized in section G of the appendix.

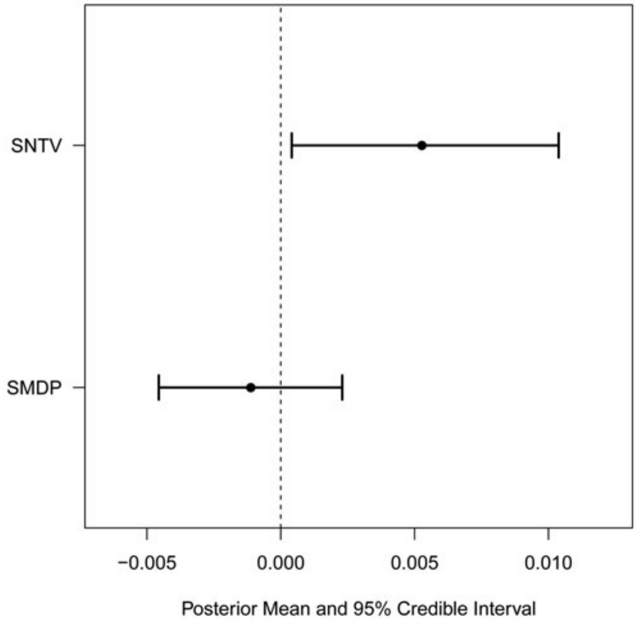

Figure 1. The effect of district-level name complexity on invalid votes.
Note: The figure shows the posterior means and 95 percent credible intervals of the effect of average name complexity on the proportion of invalid votes under SNTV (first row) and SMDP (second row). The outcome variable is log-transformed.

district-level invalid votes provides some suggestive support for one mechanism by which candidate name complexity may distort election outcomes.

3.3. Within-SNTV heterogeneity

Finally, I test heterogeneous effects within SNTV to explore a more nuanced relationship between candidate name complexity and voter behavior. Recall that under SNTV in Japan, district magnitude varied from 1 to 6, and the number of candidates in the district varied from 2 to 23. According to Carey and Hix (2011), the information environment of low-magnitude multimember districts resembles that of single member districts. In fact, some of the SNTV districts in Japan are very similar to SMDP districts in terms of the number of candidates, and voters in these districts are no more likely to suffer from informational demands than those in SMDP districts. Consequently, if my argument is correct, the visual complexity of candidate names should not have any effect on election outcomes in these SNTV districts. To examine this possibility, I add the interaction term between name complexity and the number of candidates in the district to model 2 of Table 1.[24]

Figure 2 shows the posterior marginal effect of name complexity under SNTV conditional on the number of candidates in the district. The range of the x-axis is restricted to the 0th to 90th percentiles of the number of candidates in the data, which range from 2 to 14. Dashed lines represent 95 percent credible intervals. The figure shows that the negative effect of name complexity is statistically discernible from 0 only when there are a sufficiently large number of candidates in the district (≥ 6). By contrast, in districts with a relatively small number of candidates (2–5), which resemble SMDP districts, the effect of name complexity is not statistically reliable. Therefore, even within SNTV, voters' decisions are likely to be distorted by politically irrelevant information only when the information environment becomes sufficiently demanding.

[24] I interact name complexity with the number of candidates, instead of district magnitude, because voters' reactions are affected by the actual number of candidates in the district. The number of candidates also shows more variation than district magnitude. For the model summary and additional heterogeneous effect tests, see section H of the appendix.

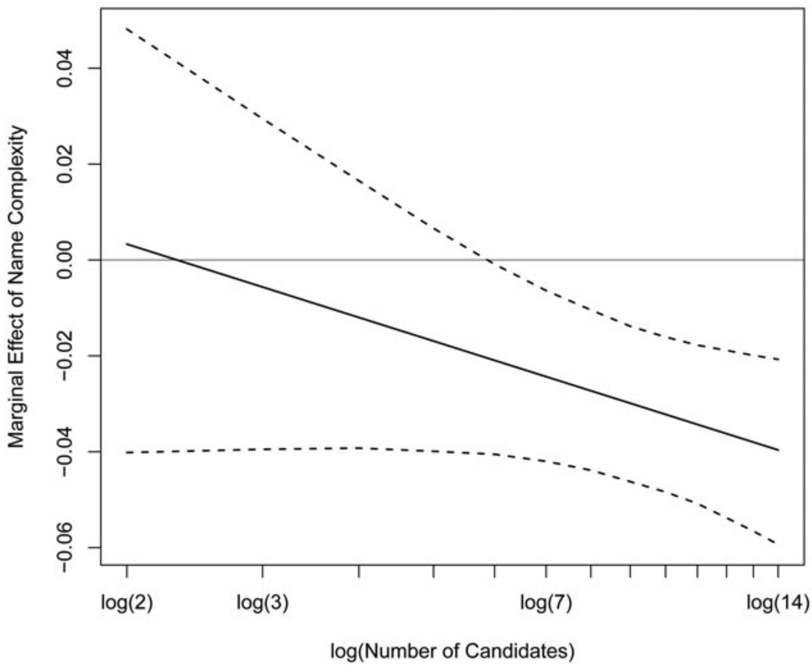

Figure 2. Heterogeneous name complexity effect by the number of candidates under SNTV.
Note: The figure shows the marginal effect of name complexity on vote share conditional on the number of candidates under SNTV. Dashed lines indicate a 95 percent credible interval.

4. Discussion and conclusion

Voters' reliance on politically irrelevant cues contradicts a fundamental principle of representative democracy: voters select representatives based on policy and performance. This behavior not only lowers the quality of selection but also has the potential to subvert the process of representation as a whole. For example, politicians may have less incentive to listen to voters who always make poorly informed decisions based on irrelevant information. Similarly, knowing that some voters are unable to make appropriate judgments, politicians may discount the electoral consequences of their misconduct, such as corruption. Therefore, the proper functioning of representative democracy may be questioned when voters' decisions are systematically affected by politically irrelevant information.

This study examines whether this kind of cue-taking behavior is conditioned by electoral systems and the information environment they generate. I find that when electoral systems require voters to go over a large number of options while simultaneously depriving the voters of the ability to rely on partisan cues, their decisions are more likely to be affected by the visual complexity of candidate names, even though it contains no meaningful information. By contrast, when electoral systems generate much simpler information environments, where voters are presented with fewer candidates and can rely on partisan cues, I fail to find the same effect of name complexity.

These findings suggest that at least in some cases, it is possible to mitigate the negative effect of politically irrelevant cues through the careful design of electoral institutions. Given the results that the effect of name complexity is substantial only when the cognitive demands of vote choice are fairly high, electoral systems that offer a simpler set of options—e.g., low-magnitude systems without intraparty competition—may be better in preventing voters' use of politically irrelevant cues. When electoral systems generate less cognitively demanding environments, voters may be able to deliberate over their options without being overwhelmed by excessive informational demands. As a result, less cognitively demanding systems may help voters filter irrelevant information and make more informed choices.

This point provides important insight into the broad debate on electoral system design. It is well known that electoral systems entail an important trade-off between accountability and representation: majoritarian systems are best suited for accountable government, whereas proportional systems are best suited for the representation of diverse interests, yet these two cannot be achieved simultaneously (Powell, 2000; Golder and Stramski, 2010; Lijphart, 2012). In an effort to reconcile the two ideals, Carey and Hix (2011) propose the idea of the "electoral sweet-spot," suggesting that low-magnitude PR systems can achieve an optimal balance between clear accountability and the representation of broad interests.

What has not been fully stressed in this debate is that the accountability-representation trade-off under different electoral rules is accompanied by different degrees of cognitive demands (Cunow, 2014; Taagepera *et al.*, 2014). Representation-oriented systems tend to create more cognitively demanding environments than accountability-oriented systems because of their permissiveness to the entry of diverse candidates. This may mean that favoring the representation aspect of electoral systems can intensify the problem of cognitive demands, increasing the chance that voters' decisions are affected by politically irrelevant cues. Echoing the "sweet-spot" argument by Carey and Hix (2011), this study cautions that too much emphasis on representation and diverse choices may not always lead to better outcomes due to increased cognitive difficulties. This concern deserves more explicit attention from electoral engineers.

Beyond electoral system design, this study also facilitates discussion of ballot design (Niemi and Herrnson, 2003; Reynolds and Steenbergen, 2006; Barnes *et al.*, 2017). Since there is no variation in ballot papers in Japan, I cannot assess how much write-in ballots drive my findings. Nevertheless, it is possible to imagine that by increasing the costs of voting, write-in ballots could heighten the chance that voters use visual name complexity as a voting cue. Without write-in ballots, name complexity might not have the same impact as shown in this study. Although this remains just speculation, the use of ballots that do not require voters to write their choices—e.g., electronic voting (Calvo *et al.*, 2009)—might be an alternative remedy for the undesirable impact of politically irrelevant cues.

Finally, this study also contributes to the long line of research on electoral reforms, especially the one in Japan. Previous studies demonstrate that Japan's 1994 reform has improved the quality of representation by reducing malapportionment (Horiuchi and Saito, 2003), constraining political inheritance (Smith, 2018), discouraging campaign emphasis on particularistic goods (Catalinac, 2016), and promoting the formation of broader support bases (Krauss and Pekkanen, 2004; Hirano, 2006). This study provides another reason to believe that the 1994 reform has led to a better outcome, showing that an unintended benefit of the institutional change from SNTV to SMDP may have been to prevent name complexity from affecting election outcomes.

Supplementary Material. The supplementary material for this article can be found at https://doi.org/10.1017/psrm.2019.37

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References

Achen CH and Bartels LM (2016) *Democracy for Realists: Why Elections Do Not Produce Responsive Government*. Princeton, NJ: Princeton University Press.

Angrist JD (2006) Instrumental variables methods in experimental criminological research: what, why and how. *Journal of Experimental Criminology* **2**, 23–44.

Augenblick N and Nicholson S (2015) Ballot position, choice fatigue, and voter behaviour. *The Review of Economic Studies* **83**, 460–480.
Banducci S, Giebler H and Kritzinger S (2017) Knowing more from less: how the information environment increases knowledge of party positions. *British Journal of Political Science* **47**, 571–588.
Barnes TD, Tchintian C and Alles S (2017) Assessing ballot structure and split ticket voting: evidence from a quasi-experiment. *The Journal of Politics* **79**, 439–456.
Blumenau J, Eggers AC, Hangartner D and Hix S (2017) Open/closed list and party choice: experimental evidence from the UK. *British Journal of Political Science* **47**, 809–827.
Calvo E, Escolar M and Pomares J (2009) Ballot design and split ticket voting in multiparty systems: experimental evidence on information effects and vote choice. *Electoral Studies* **28**, 218–231.
Carey JM and Hix S (2011) The electoral sweet spot: low-magnitude proportional electoral systems. *American Journal of Political Science* **55**, 383–397.
Carey JM and Shugart MS (1995) Incentives to cultivate a personal vote: a rank ordering of electoral formulas. *Electoral Studies* **14**, 417–439.
Catalinac A (2016) From pork to policy: the rise of programmatic campaigning in Japanese elections. *The Journal of Politics* **78**, 1–18.
Catalinac A (2018) Positioning under alternative electoral systems: evidence from Japanese candidate election manifestos. *American Political Science Review* **112**, 31–48.
Crisp B and Ingall RE (2002) Institutional engineering and the nature of representation: mapping the effects of electoral reform in Colombia. *American Journal of Political Science* **46**, 733–748.
Cunow SF (2014) *Vote choice in complex electoral environments*. Ph. D. thesis, University of California, San Diego.
Donderi DC (2006) Visual complexity: a review. *Psychological Bulletin* **132**, 73–97.
Eng HY, Chen D and Jiang Y (2005) Visual working memory for simple and complex visual stimuli. *Psychonomic Bulletin & Review* **12**, 1127–1133.
Eppler MJ and Mengis J (2004) The concept of information overload: a review of literature from organization science, accounting, marketing, MIS, and related disciplines. *The Information Society* **20**, 325–344.
Fujiwara T (2015) Voting technology, political responsiveness, and infant health: evidence from Brazil. *Econometrica* **83**, 423–464.
Fukumoto K and Miwa H (2018) Share the name, share the vote: a natural experiment of name recognition. *The Journal of Politics* **80**, 726–730.
Garrett JC and Brooks CI (1987) Effect of ballot color, sex of candidate, and sex of college students of voting age on their voting behavior. *Psychological Reports* **60**, 39–44.
Gasper JT and Reeves A (2011) Make it rain? Retrospection and the attentive electorate in the context of natural disasters. *American Journal of Political Science* **55**, 340–355.
Golder M and Stramski J (2010) Ideological congruence and electoral institutions. *American Journal of Political Science* **54**, 90–106.
Hayes D and Lawless JL (2015) As local news goes, so goes citizen engagement: media, knowledge, and participation in US house elections. *The Journal of Politics* **77**, 447–462.
Healy AJ, Malhotra N and Mo CH (2010) Irrelevant events affect voters' evaluations of government performance. *Proceedings of the National Academy of Sciences* **107**, 12804–12809.
Hirano S (2006) Electoral institutions, hometowns, and favored minorities: evidence from Japan electoral reforms. *World Politics* **59**, 51–82.
Ho DE and Imai K (2008) Estimating causal effects of ballot order from a randomized natural experiment: the California alphabet lottery, 1978–2002. *Public Opinion Quarterly* **72**, 216–240.
Horiuchi Y (2005) *Institutions, Incentives and Electoral Participation in Japan: Cross-Level and Cross-National Perspectives*. London: Routledge.
Horiuchi Y and Saito J (2003) Reapportionment and redistribution: consequences of electoral reform in Japan. *American Journal of Political Science* **47**, 669–682.
Jankowski M (2016) Voting for locals: voters' information processing strategies in open-list PR systems. *Electoral Studies* **43**, 72–84.
Jerit J, Barabas J and Bolsen T (2006) Citizens, knowledge, and the information environment. *American Journal of Political Science* **50**, 266–282.
Keller KL and Staelin R (1987) Effects of quality and quantity of information on decision effectiveness. *Journal of Consumer Research* **14**, 200–213.
Krauss ES and Pekkanen R (2004) Explaining party adaptation to electoral reform: the discreet charm of the LDP? *Journal of Japanese Studies* **30**, 1–34.
Lau RR and Redlawsk DP (2006) *How Voters Decide: Information Processing in Election Campaigns*. New York: Cambridge University Press.

Lau RR, Andersen DJ and Redlawsk DP (2008) An exploration of correct voting in recent US presidential elections. *American Journal of Political Science* **52**, 395–411.
Lijphart A (2012) *Patterns of Democracy: Government Forms and Performance in Thirty-Six Countries*. New Haven, CT: Yale University Press.
Liversedge SP, Zang C, Zhang M, Bai X, Yan G and Drieghe D (2014) The effect of visual complexity and word frequency on eye movements during Chinese reading. *Visual Cognition* **22**, 441–457.
Marcinkiewicz K and Stegmaier M (2015) Ballot position effects under compulsory and optional preferential-list PR electoral systems. *Political Behavior* **37**, 465–486.
McCubbins MD and Rosenbluth F (1995) Party provision for personal politics: dividing the vote in Japan. In Cowhey PF and McCubbins MD (Eds), *Structure and Policy in Japan and the United States*. Cambridge, NY: Cambridge University Press, pp. 35–55.
Moehler D and Conroy-Krutz J (2016) Eyes on the ballot: priming effects and ethnic voting in the developing world. *Electoral Studies* **42**, 99–113.
Mori Y and Mizusaki T (2012) *JED-M Mizusaki-Mori Syugiin Giin So-Senkyo Data 28-44*. Tokyo, Japan: Bokutakusha.
Niemi RG and Herrnson PS (2003) Beyond the butterfly: the complexity of US ballots. *Perspectives on Politics* **1**, 317–326.
O'Reilly CA (1980) Individuals and information overload in organizations: is more necessarily better? *Academy of Management Journal* **23**, 684–696.
O'Sullivan CS, Chen A, Mohapatra S, Sigelman L and Lewis E (1988) Voting in ignorance: the politics of smooth-sounding names. *Journal of Applied Social Psychology* **18**, 1094–1106.
Otokita S (2017) *Toukyoto no Yami wo Abaku*. Tokyo, Japan: Shinchosha.
Peterson E (2017) The role of the information environment in partisan voting. *The Journal of Politics* **79**, 1191–1204.
Pieters R, Wedel M and Batra R (2010) The stopping power of advertising: measures and effects of visual complexity. *Journal of Marketing* **74**, 48–60.
Powell B (2000) *Elections as Instruments of Democracy*. New Haven, CT: Yale University Press.
Reed SR and Smith DM (2017) *The Reed-Smith Japanese House of Representatives Elections Data Set (JHRED)*. Version: 23 August, 2017 Available at https://sites.google.com/site/danielmarkhamsmith/data.
Reynolds A and Steenbergen M (2006) How the world votes: the political consequences of ballot design, innovation and manipulation. *Electoral Studies* **25**, 570–598.
Rogers J and Tyszler M (2018) Information and economic voting. *Political Science Research and Methods* **6**, 753–70.
Rudolph L and Däubler T (2016) Holding individual representatives accountable: the role of electoral systems. *The Journal of Politics* **78**, 746–762.
Schaffner BF, Streb M and Wright G (2001) Tearns without uniforms: the nonpartisan ballot in state and local elections. *Political Research Quarterly* **54**, 7–30.
Shugart M and Wattenberg MP (2001) *Mixed-Member Electoral Systems: The Best of Both Worlds?* New York: Oxford University Press.
Shugart MS, Valdini ME and Suominen K (2005) Looking for locals: voter information demands and personal vote-earning attributes of legislators under proportional representation. *American Journal of Political Science* **49**, 437–449.
Silva RR, Chrobot N, Newman E, Schwarz N and Topolinski S (2017) Make it short and easy: username complexity determines trustworthiness above and beyond objective reputation. *Frontiers in Psychology* **8**, 1–21.
Smith DM (2018) *Dynasties and Democracy: The Inherited Incumbency Advantage in Japan*. Palo Alto, CA: Stanford University Press.
Snyder JM and Strömberg D (2010) Press coverage and political accountability. *Journal of Political Economy* **118**, 355–408.
Taagepera R, Selb P and Grofman B (2014) How turnout depends on the number of parties: a logical model. *Journal of Elections, Public Opinion & Parties* **24**, 393–413.
Van Grinsven B and Das E (2016) Logo design in marketing communications: brand logo complexity moderates exposure effects on brand recognition and brand attitude. *Journal of Marketing Communications* **22**, 256–270.
Zürn M and Topolinski S (2017) When trust comes easy: articulatory fluency increases transfers in the trust game. *Journal of Economic Psychology* **61**, 74–86.

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