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University of California, San Diego

2012
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ACKNOWLEDGEMENTS

It goes without saying (but I’ll say it anyways) that completing one’s Ph.D. is not an easy task, and I certainly have many people to thank.

First, I want to thank Henry Kim, and Neil Narang. Over the years Henry has been an indispensible friend, mentor, and coauthor. He has likely listened to almost every research idea I have ever had, and provided nothing but insightful and encouraging feedback. For any research idea to succeed, you need someone who will listen to it, see its contribution even better than you do, and let you know how you can make it work. I have yet to meets someone who is better at this than Henry.

Like Henry, Neil has not only been a coauthor of mine, but a great friend and ally. Like any good scientist, Neil values clarity, and it is likely no accident that he is one of the clearest thinkers I know. At various points he has listened to every idea in this dissertation and forced me to make them much sharper. Neil is also one of the most loyal and reliable people I know, and throughout graduate school, whenever I have needed Neil’s help, he has always come through.

I also owe a huge debt of gratitude to my advisor, James Fowler. This dissertation would not have been possible without an advisor possessing both James’ interests and talents. Given that I cannot think of anyone else who has them, I think it’s safe to say that without James, this project never would have happened. Throughout graduate school James has been a fantastic mentor, who has shown me that it is possible to be a productive scholar on a wide range of topics. I will also note that James is one of the most generous people I know, and has always been willing to give whatever time or resources he has to make a project work. This includes the Omnibus Political Science
Study at UCSD, which gave me the opportunity to conduct numerous experiments. The OPSS would have never happened without James.

I also want to thank Mathew McCubbins. During his time at UCSD Mat did so much to shape graduate education that there are few parts of my training that cannot be linked back to him in some way. It was Mat who first taught me what it means to be a true scientist and how to correctly conduct an experiment.

I also owe much my progress over the last several years to Sam Kernell. Without his encouragement, I probably would have never transitioned to studying American politics. For two summers, Sam also generously employed me to work on his veto-threats project; and, at several crucial points in my graduate career, Sam has been there to volunteer some exceptionally sage advice.

I should also thank the two outside members of my committee, Craig Mckenzie and Martin Paulus. Both, in their own way, showed me that experimental control means much more than randomization of the treatment.

I also want to thank members of the Human Nature Group for their friendship and for their feedback and encouragement on many of the papers here, with particular thanks to Chris Dawes, Jason Jones, Jaime Settle, Alex Hughes, and Robert Bond.

I want to similarly thank the members of my cohort for their encouragement and for providing me with many valuable conversations during grad school. In this regard, I especially want to thank Allen Bolar, Leigh Bradberry, Justin Gottschalk, Molly Hamilton, Paula Jacobson, Sarah Knoesen, Ellen Moule, Andrew Waugh, Ben Tang, and Will Terry.
I also want to thank Emilie Hafner-Burton and David Victor, both for being great collaborators and for helping to support my research. I am glad that after finishing my Ph.D. I will have a job working with such talented individuals.

Last, but perhaps most important, I want to thank my family. Without my brother and best friend Matt, I would have never made it to grad school or through it. We’ve talked almost every day, and as a result he has been there through every challenge I’ve ever faced. I also owe a huge debt of gratitude to my parents, who have always worked hard to support any goal of mine. I know that it is not easy to have a son in graduate school, and I will be forever grateful for their constant love and encouragement.
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Partisan Minds Think They Think Alike: How Projection Aids Collective Action in Parties
Polarization as a Cognitive Convention
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The three papers that comprise this dissertation all start with the premise that parties and other social groups have an incentive to coordinate their activities. Each paper then explores how this strategic incentive shapes beliefs of individuals within these parties and other organizations (Paper 1 and 2); or, how coordination within legislatures shapes the way voters come view parties and their candidates, and how this may in turn affect the cost that parties pay over time to coordinate their activities in Congress (Paper 3).
Chapter One
Coordination, Ideology, and Motivated Reasoning

Many studies of political decision making are concerned by the fact that strong partisans from both parties have highly divergent beliefs about a large number of issues, from the state of the economy to the causes of global warming, and that new information often fails to resolve or even mitigate these disagreements (Bartels 2008; Duch, Palmer, and Anderson 2000; Gerber and Huber 2010; Nyhan and Reifler 2010). Perhaps surprisingly, partisans who have the most general information about politics, and who pay the most attention to political news, disagree the most on such issues (Bartels and Achen 2006; Hoffman 2011; Shani 2006). Therefore it seems that consuming more information does always not cause individuals to resolve their initial differences. Instead, partisans might selectively accept information that conforms to their party's existing ideological view of the world (Lord, Ross, and Lepper 1979), and over time, partisans' viewpoints may simply become more consistent with the ideas espoused by party elites (Lenz 2009; Zaller 1992). These findings raise the concern that partisans' preferences will ultimately not reflect informed views about which candidates, parties, or platforms serve their true interest. Furthermore, there is a worry that presenting strong partisans with more information may fail to ameliorate this problem (Mutz 2011).

In this article I argue that this phenomenon may arise, in part, because parties and their members actually use ideological worldviews for two purposes. First ideology may
serve as a heuristic that helps simplify citizens' choices across a number of issues (Hinich and Munger 1992; Poole 2005). According to this view of ideology, partisans are primarily interested in forming more accurate views about which policies and candidates are ultimately in their best interest, but may be limited in the information they initially possess about how a particular issue area works. They should therefore continually use new information to adapt and refine their views about issues, and the fact that they do not is puzzling.

However, parties also may rely on ideologies to help coordinate their actions (Bawn 1999). Here, ideologies prescribe simple decision rules that help partisans coordinate their support and opposition to various policies and candidates. According to this second view, partisans may not do better by adopting new views that are more accurate, but differ from the simple ideas that coordinate their party's actions. If remaining coordinated with one's party is better than being perfectly right, then partisans may focus on better learning the ideas that help them consistently coordinate with others in their party, and ignore other insights that could be learned from the data that they observe.

To demonstrate this hypothesis, I present an experiment where subjects engage in a novel learning task. Similar to how partisans can navigate a number of different complex policy issues by relying on simple ideological rules (e.g. "Higher taxes are bad.")}, participants can perform this task by adopting simple heuristics that help them across a number of different choices. However, subjects may do even better over time by adopting beliefs that are more complex and accurate. Much like an ideal citizen, subjects
who are paid to be accurate typically use evidence to evolve the rules they use to make decisions, moving from simple and less accurate rules to rules that are more complex and accurate.

On the other hand, when subjects are given the incentive to coordinate with a group of agents who rely on a set of simple rules (similar to joining a party with simple ideological beliefs), they adopt beliefs that become closer and closer to the simple rules used by these agents. Once subjects in this condition become coordinated with the rest of their group, they fail to further refine their beliefs about world. Like partisans in different parties, subjects in different groups come to hold even more divergent beliefs about the world. Also like strong partisans, subjects in the coordination condition are likely to ignore new information that is discordant with their group's beliefs.

**Ideology and Motivated Reasoning**

**Ideology and Partisan Bias**

The canonical definition of ideology, given by Converse (1964), is ``What goes with what?''. That is, do citizens know which types of candidates and policies they prefer, and are these preferences consistent with a particular logic? The definition used in this article is similar. I assume that citizens face a complex world, such that it is impossible to completely understand everything about all of the political choices they face. To navigate this complexity citizens rely on an internal model that simplifies the world and helps them make predictions about which policies or candidates they prefer most. Following spatial theories of ideology (Hinich and Munger 1992; Poole 2005), I further assume that
partisan ideologies typically evaluate polices and candidates according to a simple and low-dimensional set of criteria that can apply to many different decisions. For instance, voters from one party may predict that higher taxes will slow economic growth. As a result this will cause them to oppose a wide variety of policies based on the fact that they raise tax rates.

While many theories of voting behavior assume that voters act according to an particular ideology, early research in American voting behavior forced political scientists to question this assumption. Most voters know very little about politics in general (Campbell et al. 1960; Carpini, Keeter, and Keeter 1996). Moreover, voters often don't know where they stand on many of the key issues decided by elections (Campbell et al. 1960; Converse 1964; Zaller 1992). Even when voters do report political preferences, these preferences often appear to be temporally unstable or unconnected to a clear set of principles (Converse 1964; Zaller 1992). This raised the possibility that voters do not decide according to any clear belief ideology about how to best govern their country. Instead voters may have "non-attitudes" about most issues, and choose according to criteria that are fleeting or random (Converse 1964; Zaller 1992).

More recent research, however, has changed this view, showing that voters may be much more ideological than previously thought. When measurement error is take into account, voters are often found to have fairly consistent and stable attitudes about most political issues (Achen 1975; Ansolabehere, Rodden, and Snyder 2008). Furthermore, it seems that voters are becoming more ideologically aligned over time, holding issue positions that consistently agree with the platform of one party or another (Bafumi and
Shapiro 2009; Fiorina, Abrams, and Pope 2011; Gelman et al. 2005). Perhaps unsurprisingly, this trend is especially true among politically active partisans (Bafumi and Shapiro 2009; Bartels and Achen 2006).

The fact that citizens often vote according to a stable set of beliefs and preferences is likely good for the quality of democratic decision-making. Yet, research in political behavior and psychology has also raised the concern that ideological thinking may come at a cost, biasing the way strong partisans view the world around them. This was noted in the earliest literature on voting behavior, which argued that voters tend to view new information through a partisan lens that causes voters from different parties to draw very different, and sometimes unfounded, conclusions from the same information (Berelson, Lazarsfeld, and McPhee 1954; Campbell et al. 1960). Subsequent studies have shown that politically active and attentive citizens disagree on a number of seemingly resolvable questions, from the state of the economy (Bartels 2002; Bartels and Achen 2006; Duch, Palmer, and Anderson 2000; Evans and Andersen 2006; Gerber and Huber 2010), to the scientific basis of global warming (Hoffman 2011), to whether inequality is increasing (Bartels 2007).

While no one expects that partisans should always agree on such matters, it is hard to imagine that many partisans have observed evidence that is different enough to justify the scope and depth of their divergent views (Gerber and Huber 2010). The sweeping differences that partisans exhibit over seemingly resolvable, or even factual, issues raises the possibility partisans don't use new information to refine and adjust their ideological view of the world. Instead, attentive partisans may focus on better learning
the simple dogmas that make up their party's ideology, and adjust their view of the facts to fit. For instance, a partisan might start with the view that redistributive policies are generally harmful, and then infer that inequality is not a growing problem. If this is the case then it is hard to see how democracies will develop wiser views about how to best tackle the collective challenges they face (Mutz 2011; Shapiro and Bloch Elkon 2012).

The preferences of more informed partisans may be more constrained by different partisan theories of the world, but those theories may be less constrained by new empirical facts.

There is also evidence from panel data that partisans' beliefs do not only differ over such matters cross-sectionally, but that partisans often maintain these widely divergent views in the face of new information. As noted above, partisans' divergent views ultimately generate predictions, such as whether a particular platform or party will produce a successful outcome, and therefore should be revised as individuals are exposed to pertinent information. Very simple models of belief updating (such as the running tally) predict that these views should converge as citizens view more evidence (Bartels 2002). Yet, empirical evidence suggests just the opposite. Longitudinal panel data show that instead of converging over time on a set of common beliefs about candidates, parties, and policies, the initial differences between partisan's beliefs typically persist and frequently increase over time (Bartels 2002; Bartels and Achen 2006; Gaines et al. 2007; Jacobson 2010).

A number of laboratory studies also indicate that strong partisans selectively ignore information when it contradicts their existing worldview. When strong partisans
are presented with mixed evidence about a candidate or issue, they selectively accept facts when they agree with their existing ideological beliefs, and ignore, forget, or actively avoid viewing facts to the contrary (Lodge, Steenbergen, and Brau 1995; Lord, Ross, and Lepper 1979; Taber and Lodge 2006). As a result, presenting voters from different parties with the same set of facts can lead to them to hold even more polarized beliefs. Even when the evidence is not mixed, partisans may ignore or reject such information if it goes against their existing views (Nyhan and Reifler 2010).

The Motivation Behind Motivated Reasoning

The evidence cited above has led many studies to conclude that that strong partisans do not update their beliefs as reasoner who is solely concerned with forming accurate beliefs about the world. Instead they act as "motivated reasoners" who have an incentive to maintain their pre-existing beliefs (Kunda 1990; Taber and Lodge 2006; Westen et al. 2006). However, the origins of this motivation in strong partisans are not completely understood.

The best studied cause of motivated reasoning is affective processing or "hot cognition" (Lodge and Taber 2005; Redlawsk 2002; Taber and Lodge 2006; Westen et al. 2006). Here partisans experience negative emotions when confronted with negative information about their party, and therefore seek to avoid or ignore it. This theory has been supported by studies showing that partisans avoid information sources that could be uncomfortably discordant with their world view (Redlawsk 2002; Taber and Lodge 2006). More recently it has been shown that partisans' rejection of discordant evidence is
actually mediated by brain centers associated with affective reasoning (Westen et al. 2006).

Yet, while such evidence shows that automatic and affective reasoning play a role in how partisans view the world, it does not rule out the possibility that affective reasoning is simply a proximate cause, rather than the ultimate cause of motivated reasoning in partisans. Emotions, by themselves, can drive individuals towards many different goals, and it is not obvious that they should always drive individuals to hold on to their existing beliefs. In fact, emotions are often found to be an essential component of reasoned choice and often provide individuals with the necessary incentive to pursue rational goals (Damasio 1994; Koenigs et al. 2007). If holding more accurate beliefs about the world really causes partisans to make choices that are more consistent with their underlying interests, then it remains an unresolved puzzle why emotions would push them to ignore pertinent information.

Others have argued that motivated reasoning could occur if partisans gain any hedonic utility from believing they are right because voters pay little personal cost for voting incorrectly (Caplan 2008; Downs 1957). However, this notion is contradicted by evidence that voter's ideological beliefs spill over into the individual choices partisans make about economic consumption and investment (Gerber and Huber 2009). Here, decisions made on the basis of inaccurate beliefs will directly harm an individual's welfare. Furthermore, it does not accord with the fact that partisan voters are typically among the most altruistic citizens, and therefore do not only care about how a political decision affects themselves; but also care about the widespread effect that political
decisions will have on others (Dawes, Loewen, and Fowler 2011; Fowler and Kam 2007). Therefore, a more satisfying account of motivated reasoning would allow for the fact that strong partisans do have some incentive to correctly perceive which platforms and candidates will lead to better outcomes for themselves and others.

In the next section I present such an account, arguing that strong partisans and party activists do have some incentive to make accurate inferences about the world. However, within certain bounds, they may have a primary incentive to coordinate their activities with other partisans. When these two goals are in conflict, the incentive to coordinate can cause partisans to hold onto the beliefs that coordinate the rest of their party. The point here is not that this strategic motivation is more important for understanding motivated reasoning than are other psychological processes, such as affective cognition. However, the need to coordinate one's activities is a material incentive that can reinforce these psychological processes. By manipulating this incentive alone, it is possible to show that the desire to coordinate with others can produce learning similar to what is observed in strong partisans and may help explain why such behavior persists despite the fact that partisans do have some incentive to according to accurate beliefs.

Ideology: Both a Heuristic and a Coordination Device

The Decision-Theoretic View of Ideology

One purpose of ideology is to simplify complex decisions, such that individuals can make better choices even if they do not have a lot of information about an issue or a
candidate. I will call this the decision-theoretic view of ideology. Ideology simplifies decisions by taking choices which are high-dimensional, with many different aspects and constraints, and makes them low dimensional by focusing on only one or two aspects (Hinich and Munger 1992; Poole 2005). For example, citizens might be presented with three different measures:

- Raise taxes to build a tunnel.
- Raises taxes to build a train.
- Raise taxes to build a bridge.

Despite the myriad of differences in these measures, one voter may lump them all together as government investments in infrastructure, and evaluate them according to how much they improve it. Another voter, on the other hand, may categorize these proposals as measures that raise taxes, and evaluate each measure to how much they increase or decrease citizens' tax burden. Each of these dimensions may provide a citizen with useful information about a policy’s consequences, but in many situations could also lead individuals to different conclusions. If the first voter has typically found that public infrastructure helps economic growth, they might make the prediction that each of these three measures will help grow the economy and vote for them. Meanwhile, the second voter may have learned that taxes tend to harm economic growth, predict that these measures will do the same, and vote against them.

The decision-theoretic view of ideology also leads to the expectation that these initial views will be revised as individuals are exposed to more information. Different facets of policies can interact in complex ways, such that the simple rules of thumb
provided by a particular ideology are not always accurate. For example, one ideological worldview may dislike spending partly because it tends to be inflationary. This view is generally accurate, but it will not hold in all conditions, such as when interest rates are near a zero lower bound (Eggertsson and Woodford 2003). Experience, with a particular platform might therefore cause individuals to refine their initially simple predictions, and lead individuals to converge in their beliefs about various platforms, candidates, or parties. A similar idea arises in the literature on deliberation, where normative scholars hope that by sharing information citizens will come to a more refined consensus on how to best govern a polity (Mutz 2011).

**The Strategic View of Ideology**

However, ideologies do not simply help citizens make choices in isolation. As Bawn (1999) points out, ideologies can play a crucial role in coordinating the actions of citizens. I will call this the strategic view of ideology.

Partisans have an incentive to coordinate their actions because cooperation within parties is largely built on reciprocity over time (Bawn 1999). Here one part of a coalition may take costly action on behalf of an issue that they care little about because it engenders future cooperation from other party members who do value the issue (and vice versa) (Aldrich 1995). As Bawn and others have pointed out, any repeated game of this type typically becomes a coordination game with multiple equilibria because there are many possible deals regarding which issues will be actively opposed or supported that could form the platform of a party (Bawn 1999; Skyrms 2003). The challenge then is to not only agree on a particular equilibrium of this repeated game, but to stick to it, as
deviations could cause cooperation within a party to break down or become less efficient. Similar arguments have been made by other studies, which posit that efficiently coordinating on a particular set of candidates or issue stances will aid parties in electoral competition (Calvert 1992; Cox 1997; Dewan and Myatt 2007). While voters may not fully understand the subtle details of this strategic incentive, they could certainly learn from party leaders and other political new sources that unity helps the party. Furthermore, it is most likely that politically active and attentive partisans would learn these messages. As noted above, these are the voters who tend to be most ideologically aligned with the simplistic ideologies that coordinate parties’ activities.

Ideologies can provide partisans, and especially party activists, with a coordination device because many of the predictions made by a particular ideological view also imply a simple decision rule that can coordinate partisans’ actions (Bawn 1999). For instance, the idea that taxes harm economic growth implies that one should vote against bills or politicians that raise taxes. Such actions may not always be in all partisans' interests, and on some dimensions, such actions might always go against the weak preferences of particular partisans. Yet, by sticking to these simple rules parties help stay coordinated on a particular cooperative equilibrium that on average benefits all members relative to the alternative of going it alone.

Under the strategic view of ideology, partisans may gain very little by continually refining their views about the political world if doing so moves them away from the simple ideas that coordinate their party. If each partisan cannot exert a strong influence on the ideology that coordinates his or her party, then it will often not be worth the
mental effort to continually think about how new evidence might challenge or change their parties worldview. Furthermore, there is some danger that holding different beliefs will make it more difficult to coordinate with the party. A related argument has been made by Dickson (2006), who shows formally that the incentive to coordinate may indeed lead partisans to ignore evidence when it contradicts their existing view or the world. However, Dickson assumes that it is open disagreement that causes miscoordination, rather than holding different predictive models of which policies should be supported or opposed.

There are of course limits to this line of argument, as coordination within a party is only so valuable (Dewan and Myatt 2007). Yet, given that parties in the US diverge substantially on a number of issues, helping the party closest to one's true interests may frequently trump the advantage that comes from acting according to a more informed set of views. Within certain bounds, partisans may have a primary incentive to coordinate with the rest of their party, and this may affect whether they use new information to update their beliefs.

**Experiment**

Together, the decision-theoretic and strategic view of ideology generate a simple set of hypotheses:

1. If partisans only had an incentive to be accurate, then they may start with simple, but divergent ideological views across a number of issues. Over time, however,
new evidence should cause partisans' beliefs about an issue to better reflect its various complexities.

2. If partisans also have a strategic incentive to coordinate their actions, then they will focus more on learning the simple beliefs that help them coordinate with their chosen party, and not use new information to further modify their beliefs.

As both incentives typically exist in politics, it can be difficult to test these ideas on observational data drawn from electoral politics. However, one can learn a substantial amount in a controlled experimental setting where participants face a learning problem that mimics key facets of learning an ideological worldview. To study how people learn ideologies in a novel environment, I examine how individuals learn logical category structures under two types of incentives.

1. One group of subjects is placed in a world where they see how others categorize objects, but are paid only for accurately categorizing objects themselves.

2. Another group is also paid for accuracy, but is given an additional incentive to match the actions of the actors they are paired with.

Here, logical category learning acts as a conceptual learning task that is analogous to learning an ideology in two ways:

1. Just like ideology helps individuals simplify an issue by reducing its dimensionality, categorization often groups objects according to a limited set of dimensions.
2. Logical categories are also represent simple rules that map a set of features into a particular categorization. This mimics how ideologies prescribe simple decision rules that could help coordinate partisans' actions.

Using a novel category-learning task also has the advantage of controlling subjects' prior beliefs about the world, and also controls the quality of information that subjects receive. Had the experiment used more “real world" or “political" variables, subject's responses might have been structured by strong priors about how these variables interact, making it more difficult to clearly interpret differences between the treatment and control group. Such information leakage is always a real worry for studies of rational inference and learning (Sher and McKenzie 2006) and is especially a problem for studies where subjects must choose how to model the experimental world in which they are placed (Green et al. 2010).

Furthermore, as I describe below (and further in the Supporting Information) the information that subjects observe has a clear mathematical structure where different category structures lead to different choices. This allows me to better identify how subjects model the information they observe. This means that I can more precisely measure how subjects categorize stimuli, and how those categories evolve over the course of the experiment. Such measurement would likely be impossible were I to use existing political ideologies, whose variants are not as sharply defined.

Experimental Stimuli
The category learning paradigm used in the experiment was invented by Shepard (1961) to study how easily subjects learned different types of logical category structures, and has since been modified by numerous experiments to test various theories of human concept learning (Johansen and Palmeri 2002; Medin and Schaffer 1978; Medin et al. 1982; Nosofsky 1986; Nosofsky, Palmeri, and Mckinley 1994; Pavel, Gluck, and Henkle 1988).

Experiments in this paradigm ask subjects to categorized stimuli—which vary along a set of 4 binary features—into one of two categories (In this experiment, as in many others, I labeled the categories Category A and Category B.

In the experiment, the objects being categorized were shape objects like those in Figure 1. These shape objects varied along 4 binary dimensions:

1. The shape in the center of the square could be a circle or a triangle.
2. The shape in the center of the square could be large or small.

To reduce any bias towards simply choosing one label over the other I randomized the order in which I presented the labels to subjects.

Subjects in the experiment were made aware of each of these shape object’s features and how they varied during the initial instructions. They were told that objects were categorized according to a particular rule based on the feature(s) of the objects, but that there were a number of different rules that would typically lead to a correct answer. This was done to let subjects know that they faced a deterministic world, but could profitably use categorization rules that worked probabilistically.
3. The shape in the center of the square could have a white or black fill.
4. The square border surrounding the shape could be solid or dashed.

Showing subjects these shape-objects is analogous to placing subjects into a novel world where they observe different political choices (such as the proposal of a ballot measure, or a candidate) that have many dimensions or variables.

Categorizing these objects is akin to making a prediction about the outcome of a political choice (such as a policy proposal or a candidate). Just as subjects might learn to connect certain features of a bill or candidate to predict an outcome, subjects can categorize each shape-object based on one or more of the features listed above.

**Structure of the World**

In the real world, citizens frequently make informed decisions about their preferences using low dimensional ideologies. To capture this facet of ideological decision-making, the experiment was constructed so that subjects could categorize objects according to a single dimension and do better than chance. For instance subjects could categorize objects according to the shape in the center of the object and be correct 75% of the time:

\[
\text{circle} = \text{Category A} \\
\text{triangle} = \text{Category B}
\]

Subjects could also categorize objects according to an object’s size and also be right 75% of the time:
Therefore, there were multiple simple ideologies that were helpful, but not perfectly accurate. For ease of exposition, I will refer to these rules from now on as “Shape Rule" and “Size Rule". Collectively I will refer to them as “Simple Rules”.

While subjects could profitably use simple rules, the world they faced (like the political world) was actually complex, and in order to correctly categorize objects 100% of the time, subjects needed to use a rule that was the conjunction of two other dimensions, a shape’s fill and border:

\[
(\text{White} \land \text{Solid}) \lor (\text{Black} \land \text{Dashed}) = \text{Category A} \\
(\text{White} \land \text{Dashed}) \lor (\text{Black} \land \text{Solid}) = \text{Category B}
\]

I will refer to this as the “True Rule". This rule captures the fact that while simple ideological heuristics may help citizens predict political outcomes, the actual determinants of policies often rely on the complex\(^3\) interaction of other factors.

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\(^3\) The True Rule is more complex than the simple rules according to a number of formal definitions, including “Boolean Complexity", which is the shortest logical sentence for writing a rule. Under this definition of complexity the simple rules (Shape Rule and Size Rule) have a complexity of 1 while the True rule has a complexity of 4. Boolean complexity has been shown to have a linear correspondence to the length of time humans need to learn a particular rule/concept (Feldman 2000; 2006).
As noted in previous sections, normative theorists often hope that even if citizens initially view the world through ideological rules that are simplistic and inaccurate, they will ultimately converge on a more refined understanding on how to connect different policies or governance styles to outcomes. By analogy, one might hope that even if subjects in the experiment start by considering simple, less accurate rules (such as the shape or size rule), they will converge to learning a rule that is more accurate (such as the True Rule).

In fact, humans do typically start by only considering simple categorizations of the world, and then move to considering more complex models of how to categorize objects as more data accrues (Goodman et al. 2008; Tenenbaum et al. 2011; Tenenbaum, Griffiths, and Kemp 2006). So the question was whether this would change if subjects, like partisans, were given an incentive to coordinate with a group that uses simple rules to coordinate its actions.

**Treatment**

This article's experiment differed from previous studies in categorization in two important ways:

First, instead of simply asking subjects to categorize objects as well as possible, subjects in both the treatment and control group were paid $0.01 for every time they correctly categorized a shape-object. In all but 2 sets of trials (described below), subjects were given feedback on whether they were correct and how much they earned. Thus, all
subjects had the same absolute incentive to be accurate, and (as I describe below) received the same information about their accuracy.

Second, on all but two sets of trials (described below), subjects were given feedback about how 5 artificial players had categorized an object. Subjects were told that each of these players had been programmed to use a particular rule, which may not be the “true” rule used to categorize each object. This was akin to showing subjects the actions of a party or coalition where the ideologies of other actors were relatively fixed and unchangeable by the subject themselves. This is largely realistic given the fact that voters and activists typically act within large populations. Full instructions can be found in the supporting information.

Subjects in the treatment and control conditions only differed in the incentives they were given:

Subjects in the control condition were like citizens who are unaffiliated with a particular party, and were therefore given no additional incentive to pay attention to the choices of the artificial agents they were paired with. They were only paid for accurately categorizing objects.

4 However, control subjects were given information about the agents' choices so as to make the information they received similar in every way possible. This was important given research showing that merely seeing the choices of others can have a substantial impact on how groups of individuals update their beliefs and preferences (Lorenz Goette 2010; Salganik, Dodds, and Watts 2006).
Subjects in the **treatment condition**, by contrast, were paid $0.02 additional cents every time their choice matched the majority of other agents. Thus the pay-offs to their choices reflected the pay-offs to a coordination game:

\[
\begin{array}{c|cc}
\text{Category A Object} & 1+2=3 & 1 \\
A & 0 & 0+2=2 \\
B & & \\
\end{array}
\quad
\begin{array}{c|cc}
\text{Category B Object} & 0+2=2 & 0 \\
A & 1 & 1+2=3 \\
B & & \\
\end{array}
\]

This incentive structure was akin to exogenously forcing subjects to join a party whose success depends on coordination.

I ran two separate versions of the experiment, which varied the simple rule used by the experiment's artificial agents. This was analogous to pairing subjects with different parties. In one version, subjects played with 4 artificial agents who used the Shape Rule and one artificial agent who used the Size Rule. I’ll call this the **Shape-Party**. In the

\[5\]

\[6\]

Having one agent use the opposite rule meant that subjects were always exposed to both simple rules.
other version, subjects played with 4 artificial agents who used the Size Rule and one artificial agent who used the Shape Rule. I’ll call this the **Size-Party**.

### Structure of the Learning Task

The experiment used the supervised learning version of Shepard's paradigm (1961). In this version, subjects categorize objects across two types of trials, *training* trials and *transfer* trials. The order of these trials is shown in Figure 2.

In training trials subjects are given feedback on whether they correctly categorized an object as belonging to Category A or Category B. This feedback helped subjects learn whether their existing perspective did a good or poor job of predicting categories, much like citizens might observe evidence that either supports or contradicts their existing beliefs about how the political world works. Subjects were trained over 10 blocks. In each block subjects categorized 8 training stimuli in random order, receiving feedback immediately after categorizing each object (See Supporting Information for an example of this feedback).

After training block 3 and after training block 10, subjects completed a *transfer block*. In each transfer block subjects were shown novel stimuli in random order and were given no feedback. As I discuss further in the supporting information, these stimuli were constructed to measure whether a subject had learned a particular category structure at different points in the experiment. This allowed me to measure subject’s true beliefs in both experimental conditions. If treatment group subjects still differed from control group subjects in the way they categorized transfer stimuli, then coordination incentives had
actually changed the way subjects understood the world in which they had been placed. There was no possibility that subjects had simply memorized the correct answer to these transfer items because they were given no feedback.

**Hypotheses**

**Hypothesis 1 - Partisan Simplicity**: I have argued that even informed partisans will interpret political choices and events through the lens of a simplistic ideology. This is because simple beliefs help them coordinate their activities with the rest of their party. Analogously, I expect that subjects in treatment group will continually act according to views that are simple, but less accurate. This will allow them to better coordinate with agents who rely on simple rules. Meanwhile, control group subjects will continually refine how they categorize each shape-object, becoming more and more accurate over time.

**Hypothesis 2 - Informed Polarization**: As discussed earlier, voters from different parties typically become more polarized as they become more politically informed. I have argued that this is because voters from different parties have an incentive to focus on learning the simple, but different, ideologies that coordinate the members of their coalition. Therefore, within the treatment, group I expect that subjects paired with

---

7 To make sure that subject understood that transfer blocks were different subjects in both experimental conditions were informed prior to a transfer block that they would be given no feedback and that they would be paid only for correctness. They had to confirm reading this by checking a box before they could proceed.
different agents (who rely on different simple rules) will increasingly diverge in how they categorize objects because the rule used by each group disagrees. That is, if the shape rule and size rule disagree on how to categorize an object, then a subject paired with a shape rule will come to increasingly with a subject paired with the size rule.

**Hypothesis 3 – Cognitive Spillover:** Subjects have a primary incentive to either categorize objects accurately (control condition), or coordinate how they categorize an object with other agents (treatment condition). Again, this was meant to capture the fact that when citizens learn about political, they are likely focused on how information will affect their political decisions. However, as I described in earlier sections, partisans divergent views often spillover into non-political decisions (such as choices about individual economic consumption, or how to answer survey question where any incentive to coordinate with one’s party is greatly reduced). In the context of this experiment, I expect that the effect of these primary incentives will spillover into transfer rounds, where subjects have the same incentive to accurately categorize novel shape-objects.

**Results**

To show that coordinating with a group caused subjects in the treatment group to persist in relying on simple, but less accurate rules (much like strong and informed partisans focus on learning their party’s simplistic ideology), Figure 3 plots the average number of errors that subjects made categorizing shape objects across the 10 training blocks.
As expected the control group continually refined how they categorized objects, much like an ideal citizen might continually refine how they connected political choices to outcomes. By the final 4 training blocks, the mean error rate for the control group was well below 25 percent, which is the error rate expected of subjects who stick to either of the two simple rules. Treatment subjects, on the other hand, never achieve a mean error rate below 27%. This suggests that most subjects in the treatment group did not converge on using anything more accurate than one of the two simple rules. Instead, most subjects in this group likely focused on learning a rule that would allow them to coordinate with their group, and stopped refining how they categorized the world as soon as they were able to perfectly coordinate with a majority of agents. The plotted 95% confidence intervals show that these differences were statistically significant.

To see whether treatment subjects paired with the Shape-Party diverged over time from subjects paired with the Size-Party, I looked at the mean error rate in each round for shape-objects where the shape-rule and size-rule would differ. These objects are labeled A3, A4, B3, and B4, and are further described in the supporting information. As shown in Figure 4, Subjects who needed to coordinate with the Shape-Party diverged overtime from subjects paired with the Size-Party. This replicates the finding that partisans with the most information come to disagree the most on a number of issues.

To see whether there was cognitive spillover, I used shape objects in the transfer block that were designed to diagnose whether subjects were acting according to one of the two simple rules (shape-rule or size-rule), or whether they were acting according to
the more complex and accurate true-rule\textsuperscript{8}. If subjects were using the true-rule they would, of course, categorize these stimuli correctly. However, if subjects were acting according to either simple rule, they would always categorize these stimuli incorrectly. As, subjects in both conditions were paid only for accuracy, it is likely that the way they categorized theses objects reflected their true beliefs.

Figure 5 shows that, across diagnostic transfer block stimuli, the mean error rate for treatment subjects is still significantly higher than the error rate of subjects in the control group, and that it is also higher than what would be observed if these subjects guessed according to random chance. Therefore, in the course of trying to coordinate with other agents, treatment group subjects came to form different beliefs about how to categorize the world. Again, this mimics the finding that partisan divergence shows up in contexts like survey-response and economic consumption where partisans lack a strong coordination incentive, and may even have a substantial accuracy incentive.

**Conclusion**

So what have we learned from this simple experiment? Some might say it is obvious that if you pay subjects more to match other agents than you pay them to be correct, they will of course pay attention to the agents and not to the truth. While further research will be needed to look at whether attention actually mediates the results found in this article, I basically agree, it is natural to suppose this will happen. Yet up until this

\textsuperscript{8} These shape-objects are labeled N1, N2, N5, and N6, in the supporting information, which describes them further.
point, much of the literature in political psychology has ignored that institutions of political competition often foist a similar payment scheme on partisans. By directly manipulating one factor, payment for coordination, while keeping other things constant

Methodologically, this paper has shown that categorization experiments provide a tractable platform for studying how decision-makers' learn to interpret political issues through different ideological lenses. Most experiments in voter learning have focused on how and when citizens can learn new facts about the world, rather than how they evolve their interpretation of facts. This has limited our understanding of how information affects the choices of voters. Whether or not citizens can get the facts they need to make reasoned choices is important, but it is also important to understand the conditions under which voters will improve the way they use those facts. Here I have shown that this can be carefully studied and measured using existing paradigms from psychology, and that these paradigms are simple enough that they can be interacted with different strategic incentives. Researchers can now go beyond simply trying to measure how voter's structure information, and experimentally test how those structures are changed by the strategic incentives that different institutions impose on actors.

Lastly, as I alluded to at the beginning of this paper, much of political psychology is focused on whether citizens' cognitive processes make them well suited to institutions that often appear to be designed with highly informed and rational actors in mind. Researchers often worry that citizens who deviate from the rationalist ideal will not effectively use existing institutions. However, this article reverses the causal arrow, looking at how the strategic incentives inherent to parties and political competition can
distort the perceptions and learning processes of citizens such that they diverge from the rationalist ideal. If we want citizens to be more responsive to the accuracy of their beliefs we may have to use institutions of opinion aggregation that do not incentivize coordination the way political competition often does. Instead, society may sometimes want to consider institutions such as information markets, which pay only for correctness, and pay even more when correct answers are discordant with the majority.
FIGURES AND TABLES
Figure 1.1 Example Shape-Objects Categorized in the Experiment
Figure 1.2 Order of Category Learning Task

- **3 Training Blocks**: Each block presents all 8 training items in random order.
- **First Transfer Block**: Present 8 Novel Items with no feedback. All subjects paid only for correctness.
- **7 More Training Blocks**
- **Final Transfer Block**
Figure 1.3 Subject’s Error Rate Over Training Rounds
Disagreements emerge and persist among different treatment groups.

Figure 1.4 Disagreement Over Time Within the Control Group
Figure 1.5 Cognitive Spillover in Subject’s Beliefs
Supporting Information

Category structure

Table 1.1 Category structure used in the experiment.

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Dim1</th>
<th>Dim2</th>
<th>Dim3</th>
<th>Dim4</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>A2</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>A3</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>A4</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>B1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>B2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>B3</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>B4</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>N1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>N2</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>N3</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
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<tr>
<td>N4</td>
<td>1</td>
<td>0</td>
<td>1</td>
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<tr>
<td>N5</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>N6</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
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<tr>
<td>N7</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>N8</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

The category structure I trained and tested subjects on comes from (Medin et al. 1982), and is based on the powerset of 4 binary dimensions. As I discuss in the main text,
the category structure I used was purposefully constructed to place subjects in a world
where the most accurate categorization rules were more complex than the rules subjects
would initially consider. This mimicked a political world more complex than the simple
ideological views that voters might initially consider.

The category structure itself is displayed above in Table 1. The way to read this
table is as follows:

Each row of the table corresponds to one shape-object that a subject was asked to
categorize.

Each of the 4 columns labeled Dim1, Dim2, Dim3, Dim4 refer to one of the 4
binary dimensions that characterized an object. So, one feature to dimension mapping
might be Dim1=Circle or Triangle, Dim2=Small or Large, Dim3=White or Black,
Dim4=Solid or Dashed Border.

1's and 0's in the table code the value that a feature takes on. If the column Dim1
corresponds to Circle/Triangle, then a 1 means the shape object has a circle, and a 0
means it has a triangle. As an example, shape object A1 (coded in the table as 1111) has a
small white circle surrounded by a solid border, while shape A3 (coded as 0111) has a
small white triangle surrounded by a solid border. As a further example, the first shape-
object in Figure 1 from the main text (a large white circle with a solid border) would
correspond to row N4 in Table 1 above (and is coded 1011).
The training phase stimuli shown in the top half of the Table 1 were the stimuli on which subjects were given feedback about whether their choices were correct. Items A1-A4 belong to Category A, while items B1-B4 belong to Category B.

Training stimuli were constructed such that subjects could do better than chance if they used a single dimension to categorize the objects. This mimics how members of different parties might profitably act according to simple, low-dimensional decision rules.

Using either the first or the second dimension of an object (columns Dim1 and Dim2 in Table 1) allowed a subject to correctly categorize training objects 75% of the time. The first dimension is the Shape-Rule from the main text. The second dimension is the size rule.

The transfer stimuli (N1-N8 in Table 1) were constructed to help distinguish which rule a person was using. In particular N1, N2, N5, and N6 are very diagnostic in determining whether a subject was using a simple rule instead of the (more complex and more accurate) True Rule. If a subject was using either simple rule on stimuli N1 and N2 they would say these objects belonged to Category B. If, however, they were using the True Rule they would say the objects belonged to Category A. The reverse is true for stimuli N5 and N6. Among subjects using simple rules, stimuli N3, N4, N7 and N8 helped to distinguish which dimension subjects were focusing on (i.e. whether they were using the Shape Rule or the Size Rule).
Methods and Materials

Recruitment: The experiment was run online using the software Qualtrics. 440 subjects were recruited from the online labor market Amazon Mechanical Turk. Access was restricted to subjects who had successfully completed 95% of their previous tasks in this market, and prior to participating in the experiment subjects had to successfully complete a quiz that tested their comprehension of the instructions. To prevent any bias in attrition, the instructions and quiz were constructed to be as similar as possible across each condition. Tests show no imbalance on any of the demographics collected post experiment. Access was not restricted to any geography, so many subjects came from countries other than the U.S.

Subject Compensation: Subjects were paid a $0.75 show up fee. The experiment took subjects an average of 21 minutes to complete. In addition to the show up fee, subjects earned money in the experiment, as described in the main text. Importantly, previous studies have shown that experiments run on this pool, using comparable stakes have successfully replicated the results of numerous lab based experiments in economics which used stakes of $10-$20 (Horton, Rand, and Zeckhauser 2010; Mason and Suri n.d.; Rand 2012; Suri and Watts 2010), and the rate of payment that subjects received exceeds the reservation price of most workers in this labor market (Horton, Rand, and Zeckhauser 2010). This is especially true given that many subjects in our experiment came from countries with average wages that are substantially lower than wages in the US.
Studies have also shown that the wage level in such experiments primarily determines whether subjects on Amazon turk will participate, but do not determine the quality of work produced (Mason and Suri n.d.). This also fits with research in experimental economics indicating that the largest difference in behavior comes from paying subjects in manner that is directly tied to their actions, and higher stakes typically exert little effect on how subjects behave (Camerer and Hogarth 1999).

**Assignment to Treatment:** Upon showing up at the experiment’s webpage, subjects were assigned at random to either the treatment condition or the control condition. Each condition differed according to the incentives and instructions that subjects received.

**Task:** Prior to completing the experiment subjects read instructions that are presented in Section A of the supplementary information. They were then required to complete a series of quiz questions designed to make sure each subject understood the task. Experimental stimuli, were presented in the order and manner described in the main task. Examples of learning feedback stimuli are presented in Section B of the supplementary information.
References


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Chapter Two
Selective Attention to Public Signals in Coordination Games

Both theoretical models (Cass and Shell 1983; Dewan and Myatt 2007; Morris and Shin 2002; Woodford 1990) and economic experiments (Cass and Shell 1983; Cornand and Heinemann 2010; Dewan and Myatt 2007; Heinemann, Nagel, and Ockenfels 2004; Morris and Shin 2002; Woodford 1990) show that players in coordination games frequently use public signals to coordinate their actions. This can cause public events, such as speeches, announcements, and ceremonies to have a profound influence on individuals’ actions relative to other informational signals (Chwe 2003). However, there is some evidence that public events can also exert a disproportionate influence on individuals’ beliefs (Chwe 1998; 2003; Lenz 2009). Yet, when or why this actually occurs remains much less well understood. One reason public signals could disproportionately influence individuals’ beliefs in coordination games—even if actors have no intrinsic taste for conformity in beliefs—is that attention is both costly and limited (Simons and Chabris 1999). As a result, actors in coordination games may focus their attention more on public signals because these signals are more likely to determine their actions (Dewan and Myatt 2007; Myatt and Wallace 2012). Here, I demonstrate this effect using an incentivized game-theoretic experiment where two players receive information in the form of public signals, which are common knowledge to both players, and private signals, which are only seen by one player or the other. Results demonstrate
that players in a coordination game bias their actions in the direction of public signals by selectively remembering them. Meanwhile, control subjects, incentivized to accurately match their actions to an unknown state of the world, update their beliefs about the state of the world according to Bayes-rule. Meanwhile, control subjects, incentivized to accurately match their actions to an unknown state of the world, update their beliefs about the state of the world according to Bayes-rule. The results add to a growing body of evidence that human perceptual biases may be significantly affected by individuals’ strategic environment (Bednar and Page 2007; Dickson 2006; Heifetz, Shannon, and Spiegel 2006; Johnson and Fowler 2011).

In many areas of social life, individuals appear to be particularly influenced by public events. For instance, Presidential speeches are often thought to be influential because they are so widely viewed (Baum and Kernell 1999; Calvert 1992; Kernell 1997). Similarly, a virtue of markets is that they can efficiently aggregate information about particular assets (Fama and MacBeth 1973), but market prices can be disproportionately influenced by public announcements from official bodies, such as the Federal Reserve (Allen, Morris, and al 2006; Frankel, Morris, and Pauzner 2003; Morris and Shin 2002). Likewise, many cultures and societies rely on highly visible public ceremonies to reinforce their most important customs, norms, and institutions (Chwe 2003).

In each of the cases listed above, the influence of public events or announcements may stem from a number of sources. For instance, public events may reinforce important cultural narratives (Geertz 1973), or be conducted by individuals that society implicitly
trusts (Crawford and Sobel 1982; Lupia and McCubbins 2003). However, this article focuses on the fact that public events often represent informational signals that help individuals strategically coordinate their actions. In this vein, Presidential speeches may be important because they are simultaneously visible to political activists who need to coordinate their support or opposition to different policies (Dewan and Myatt 2007; 2008). Public announcements are also important to market speculators who want to coordinate their investments with the market's near-term movements (Dewan and Myatt 2007; 2008). Furthermore, customs and norms can also be modeled as a coordination game where individuals wish to follow a particular behavior if others do the same (Bednar and Page 2007; Chwe 1998; Young 1993); public ceremonies may therefore provide citizens with important cues about what behaviors others are likely to follow (Chwe 2003).

The basic intuition for why individuals are more likely to follow public signals in coordination games can be described in reference to the simple 2-player game depicted in Figure 1. Here each player can pick one of two actions, A or B, and gains utility 1 if their actions match, 0 otherwise. Player 1 therefore only wants to take a particular action if Player 2 does the same, and vice versa. As a result, Player 1 should also be more likely to act on signals if Player 2 could also know to act on them, and vice versa. Public signals, which are simultaneously visible to both players, fit this requirement, and in many cases such signals may be necessary if individuals wish to reliably coordinate their actions (Rubinstein 1989). Following a similar intuition, numerous models of coordination under uncertainty have shown that players will base their strategies mostly or entirely on public signals, even if other equally informative private signals exist (}.
Yet, while coordination games provide a powerful explanation for the influence of public events in everyday life, the explanation often appears to be incomplete. Such models typically explain why individuals' actions are more likely to follow public signals, but many public signals also appear to disproportionately influence individuals' beliefs. For example, unlike many other sources of information, party leaders can reliably persuade partisans to change their stance on an issue (Lenz 2009; Zaller 1992). However, this change is not simply reflected in how partisans vote; it is also reflected in the changed beliefs that partisans report in longitudinal surveys (Lenz 2009). Similarly, economic bubbles are often modeled in terms of investors rationally trying to coordinate on public, but ultimately erroneous, information (Cabrales, Nagel, and Armenter 2007; Hommes et al. 2004; Morris and Shin 2002). Yet, surveys show that investors' beliefs are also influenced by highly visible trends in an assets' price and frequently ignore other available information, such that existence of a bubble catches many actors by surprise (Lenz 2009). Cultural differences are also not simple differences in how humans act, but also reflect differences in how individuals think about the world (Bednar and Page 2007; Greif 1994; Van den Steen 2010); and many public ceremonies are aimed squarely at influencing individual's beliefs more than competing sources of information (Chwe 1998; 2003).

Could it be that individuals’ incentive to coordinate not only causes public signals to influence their actions, but also their beliefs? A simple explanation for why public signals in coordination games may disproportionately influence beliefs is that human attention is costly and scarce (Simons and Chabris 1999). It is therefore likely that humans will pay more attention to the signals that ultimately determine their actions, and
may ignore other signals that are superfluous. In coordination games, this means that humans may pay more attention to public signals, even if they have easy access to other signals that convey just as much information about the world at large (Dewan and Myatt 2007; Myatt and Wallace 2012). This simple idea could help explain some of phenomena noted above. In each case, individuals may focus so much on the signals that help them coordinate with others that they miss other information that is right in front of their face. However, this simple idea has not yet been tested.

Here I demonstrate this phenomenon experimentally using a coordination game where players see two types of signals:

1. **Public signals** are jointly observed by both players and are thus common-knowledge.

2. **Private signals** are only observed by one player.

Because both types of signals are drawn from the same distribution, they convey exactly the same quality of information about an unknown state of the world. Therefore, if players update their beliefs according to Bayes rule, posterior beliefs about this unknown state should equally weight both types of signals. However, players can use public signals to perfectly coordinate their actions, and potentially ignore private signals when forming their strategy. It is therefore possible to show that players in such games do not always follow Bayes rule, updating their beliefs in proportion to the amount of information that a signal conveys. Instead, after playing the game, players report beliefs that are biased toward public signals in direct proportion to how public signals influence their strategy.
Control subjects, paid only to accurately report the true state of the world, do not exhibit the same bias. Here the informational and strategic value of signals is perfectly correlated. As a result, players in the control group report beliefs that, like a Bayesian learner, place equal weight on public and private signals. Thus, it is clear that non-Bayesian beliefs in the treatment condition are the result of individuals adapting their perceptions to their strategic incentive. Yet while players in the control condition report beliefs that are closer to the true state of the world, they do worse when asked to play the same coordination game as subjects in the treatment group. It is therefore also the case that biased beliefs of treatment subjects give them a clear fitness advantage in coordinating with others, and might be expected to persist in populations where there is a strong incentive for actors to coordinate their actions.

**Signals**

Subjects in both the experiment's treatment and control conditions played a game online where they observed a series of binary signals in the form of colored balls drawn from a virtual jar. Prior to the experiment, subjects were told that the jar contained 12 balls, and that some proportion of these balls were colored orange and others were colored blue. However, subjects were not told the true distribution of colors in the jar, nor were they told how likely any particular distribution of colors was. This was done to prevent subjects from forming a common prior belief over how signals were distributed, increasing the chance that subjects would base their strategies on the signals they actually observed.
Before to making a decision, subjects in both conditions were informed that we had paired them at random with another participant in the experiment, and that each participant would observe 24 draws with replacement from the virtual jar.

1. 12 Public signals, jointly observed by both players (Fig. 2a).

2. 12 Private signals, observed by one player but not the other (Fig. 2b)

As noted above, public signals conveyed exactly the same information as private signals about the true proportion of colors in the jar, but public signals were strategically more important in the coordination game that treatment subjects played (described below) because these signals were common-knowledge to both players. Private signals, on the other hand, were neither common nor mutual knowledge. A signal \( x \) is common-knowledge if each player knows \( x \), knows that each other player knows \( x \), knows that each player knows that each other player knows \( x \)... and so on, ad infinitum (Aumann 1976). Common knowledge (or near common knowledge) is frequently required for agents to know how to coordinate their actions (Monderer and Samet 1989; Rubinstein 1989). Consistent with this argument, proofs in the Supporting Information show that in equilibrium agents will only rely on public signals to coordinate their actions in the experiment.

The infinite recursion in beliefs that underlies common-knowledge may seem complex for humans to understand. However, another definition of common-knowledge also exists, which implies the same infinite recursion but does not require that subjects
think through it. An event $x$ is common knowledge if it is “self evident”, such that its occurrence implies that all players know $x$ (Aumann 1976).

The “self evident” definition of common knowledge is easier to verify, and it is likely that humans have evolved a unique capacity for understanding this version. For instance, at an early age humans exhibit a unique capacity for understanding when they and other individuals are jointly attending to a particular event, such that it would be self evident to both individuals (Carpenter et al. 1998; Saxe, Carey, and Kanwisher 2004; Tomasello, Kruger, and Ratner 2010). The instructions to the game were designed to make it clear that if a signal was public then it was, by definition, visible to both players. This was paired with illustrations implying that public signals were visible as if the two players were jointly gazing at them (as shown in Fig. 2a). Players were quizzed on this to make sure they understood, and also assured that the other player had to pass the same quiz. This was to further reinforce the fact that these signals were known by both players to be self-evident (See the Supporting Information for full instructions and quiz questions).

**Treatment**

Subjects in the treatment group (which I will label the “coordination condition”) were assigned to a coordination game where they were asked what proportion of the 12 balls were orange, labeled $P_{oi}$ for each player, $i$. Subjects were paid 1 MU = 1 USD if both players in the game reported the same number.
Subjects in the control group (which I will label the “accuracy condition”) were told that their choice would not depend in any way with what the other player chose. They would be paid 1 MU if their stated proportion, $P_{oi}$, matched the actual proportion in the jar. However, they were still paired with another player, and told so, in order to rule out the possibility that differences between control and treatment were due to some innate preference for conformity with other individuals.

**Strategies**

Subjects in the treatment condition were playing a coordination game where for players $i$ and $j$ any pair of matching proportions $P_{oi} = P_{oj}$ is an equilibrium. However, because subjects were not given a common prior over the distribution of signals it is assumed that they could not readily coordinate on an arbitrary equilibrium of the game. Instead, a more natural strategy in both the treatment and control condition is for player $i$ to pick a proportion, $P_{oi}$, that is a linear combination of observed signals. For a player $i$, such a strategy can be written

$$P_{oi} = \alpha(Public_{oi}) + (1-\alpha)(Private_{oi})$$

Where $P_{oi}$ is the number of orange signals that player $i$ reports, $Public_{oi}$ is the number of orange public signals that both subjects observe, and $Private_{oi}$ is the number of private signals that player $i$ sees. $\alpha$ is a weight $\in [0,1]$ that each player attaches to public signals vs. private signals.

For strategies described by eqn. 1, there is a unique Nash equilibrium in the coordination game where both players set $\alpha$ equal to 1. The proof is given in the
Supporting Information. Intuitively, however, this strategy amounts to both players simply reporting the number of public orange signals they saw, allowing players to perfectly coordinate their statements. Any other $\alpha$ carries some risk of mis-coordination.

Subjects in the control condition maximize their chance of winning the prize by minimizing the expected distance of their stated proportion from the true proportion. Their best guess about the true proportion is the proportion of orange signals observed. Therefore, their optimal strategy is to play according to eqn. 1, setting $\alpha$ to 0.5. This is also proved in the Supporting Information.

Results

Here three hypotheses are tested:

Hypothesis 1 - Subjects in the coordination game will play strategies that are linear in their signals with $\alpha=1$, meaning they will place full-weight on the public signals they observe. While subjects in the control condition will play their optimal strategy, $\alpha=0.5$, meaning they place equal weight on both public and private signals.

Hypothesis 2 - Subjects in the coordination condition will only pay attention to the signals they need to form their strategy, causing them to form beliefs about the proportion of orange signals that are biased in the direction of the public signals they observe. This hypothesis fits with numerous studies in cognitive psychology showing that attention is scarce (. Therefore players in the coordination game should not pay the mental cost of encoding private signals in memory. Meanwhile, assuming that the cost of remembering a signal is less than the expected benefit of being more accurate, subjects in
the control condition should remember the full distribution of signals. They may, however, fail to remember which signals were private and which were public, as this information is not essential to their strategy.

**Hypothesis 3** - By biasing their attention and beliefs in the direction of public signals, subjects gain a fitness advantage in terms of coordinating with one another. If individuals in the treatment group selectively attend to public signals because attention is scarce then one might expect control subjects in the accuracy condition to similarly focus on information that is crucial to their task, and miss information that could later help them coordinate. For example, subjects in the accuracy condition could have failed to remember which signals were public and which were private because this aspect was inessential to their main task.

H1 was tested by using Huber regression to estimate $\alpha$ for each group:

$$P_{oi} - Private_{oi} = \alpha(Public_{oi} - Private_{oi})$$

Figure 3a illustrates both the theoretical levels of $\alpha$ implied by H1, as well as the estimates of $\alpha$ for both the control and treatment groups. As predicted, subjects in the Accuracy condition were estimated to play a strategy where $\alpha$ equals 0.501 (SE 0.029). Full estimates and tables can be found in the Supporting Information.

Also as expected, subjects in the treatment condition played a strategy with a higher alpha, and were therefore more reliant on public signals. The estimated $\alpha$ for subjects in the coordination condition is .611, and this is significantly higher than control subjects’ (p-value < 0.007). However, it is also lower than the equilibrium value of 1.
Subjects’ under-utilization of public signals in the coordination condition is consistent with previous experiments (Cornand and Heinemann 2010), and are there multiple reasons why players in the coordination condition may have failed to play this equilibrium strategy. One rationale explored by Cornand et al. (2010) is that subjects engage in limited strategic reasoning. However, another possible culprit is that subjects’ intuitions about such games have been learned under conditions of strategic uncertainty, where other players sometimes fail to best respond to their own incentives. Several comments in a post experiment questionnaire exemplify this uncertainty. For example:

“The best strategy is to use only Public Draws. We'll see if my opponent understands this”

It is easy to show that such uncertainty would also flatten out subjects responses towards $\alpha =0.5$. Unfortunately, the structure of the experiment does not make it possible to discern how much of subjects’ deviation from equilibrium was due to individuals’ level of strategic uncertainty. However, it will be possible to show that to the extent that players did bias their strategy towards their public signals, they also biased their perception of the true proportion of colors in the jar.

Testing H2 required a credible measure of players’ beliefs after they had participated in the coordination game. To do this, I informed players after the coordination game that they had an unexpected chance to earn an extra 1 USD if they could correctly state the true proportion of colors in the jar. This provided subjects with a clear incentive to reveal their true belief, and was monetarily equivalent to their incentive for playing the coordination game. Fig. 3b plots players’ beliefs as a function their
strategy, $P_{oi}$, from the coordination game. This shows that treatment subjects’ beliefs largely follow their strategy in the coordination game.

Mediation analysis further shows that if being placed in the coordination game biased players’ strategies in the direction of public signals, it also biased their beliefs in the same direction. Here the outcome variable, $y$, is how much players’ beliefs deviate from their private signal proportional to how much their public signal deviated from their private signal. Intuitively, this measure is similar to $\alpha$, and shows how much more players’ beliefs are influenced by public signals compared to private signals. The mediator, $m$, is how much players’ strategies deviated from their private signal proportional to how much their public signal deviated from their private signal. The treatment variable is whether or not a subject was in the coordination condition:

$$y_i = \frac{Belief - Private_{oi}}{Public_{o} - Private_{oi}}, \quad m_i = \frac{P_{oi} - Private_{oi}}{Public_{o} - Private_{oi}}, \quad T_i \in \{\text{Coordination, Accuracy}\}$$

Figure 3c shows the results of a Sobel test (Baron and Kenny 1986). As expected, there is an average causal mediation effect (ACME), meaning that being placed in the coordination game biased subject's beliefs towards their public signals to the extent that it also biased their strategy towards these same signals in the coordination game. This mediation effect represents 91% of the treatment’s total effect on subject’s reported beliefs.

Lastly, one might wonder if the perceptual bias exhibited by subjects in the coordination game caused them to gain any advantage in terms of coordinating with other individuals. That is, did focusing more on public signals cause subjects to do better than
they otherwise might? If individuals in the treatment group selectively attend to public signals because attention is scarce then one might expect that control subjects, who did not focus as much on public signals, may have missed something. For example, subjects in the accuracy condition could have failed to remember which signals were public and which were private because this aspect was inessential to their main task.

To test H3, subjects who had been paired in the accuracy condition were subsequently asked to coordinate with one another for the same monetary prize at treatment subjects (1 MU=1 USD) (Instructions in the Supporting Information). As expected, control subjects in the accuracy condition do worse at coordinating. Like treatment subjects in the coordination condition, control subjects often play a strategy in this bonus task that is little different from what they played in their main task. Figure 3d shows the distribution of average pay-offs each subject would earn in the coordination game if they were paired against all other players who observed the same distribution of public signals. This simulates how well each subject would fare against all of the subjects they could have been paired with in the experiment. On average subjects in the treatment condition coordinate 5% more than subjects in the control condition, and this difference is statistically significant (t-test p-value < 0.008, Wilcoxon ranksum test p-value = 0.003).

Discussion

If actors update their beliefs according to Bayes-rule, then their posterior beliefs should weight signals relative to their informational content. However, it is well known that human attention is limited, and so humans may not update their beliefs based on all of the signals they observe. In strategic games, such as the coordination game studied
here, this can mean that humans update their belief based on whether or not a signal is strategically valuable. As a result, individuals' subsequent beliefs can be ill calibrated to other tasks, such as accurately reporting the information they have observed, and it may appear as if people have drawn irrational conclusions from the information in front of them. For example, investors might fail to notice information suggesting that home prices cannot rise indefinitely or partisans may fail to notice the negative consequences of policies if party leaders elide over them. Similarly, individuals raised in different cultures may fail to notice how certain norms or standards are inconvenient. In each of the cases above, noticing such things would not help actors better coordinate their actions with those around them.

Interestingly, however, the experiment in this paper also demonstrates that limited attention works both ways, and individuals who were not initially trying to coordinate with their partner failed to notice things that would have helped them coordinate later on. This suggests that actors who focus on public signals in coordination games act in a way that, given their immediate concern, is actually adaptive. More generally, the perceptual bias exhibited by subjects in the coordination condition still allows individuals to play according to a Nash equilibrium of the game that is also evolutionarily stable. Therefore, like many other perceptual biases (Dickson 2006; Heifetz, Shannon, and Spiegel 2006; Johnson and Fowler 2009), selective attention to public signals could persist in coordination games where actors revise their perceptions if doing so improves their material payoffs. If anything, one might expect this bias to become stronger when the
stakes for coordination are higher, or when individuals have more practice in a particular coordination game.

Future work will want to look at whether selective attention to public signals can help explain behavior and beliefs across other scenarios where there is substantial variation in both the incentive to coordinate and the publicity of informational signals. In order to make clearer inferences, the above experiment was designed to cleanly isolate signals' strategic value from their informational value. In the real world, however, it is rarely the case that signals are purely public or private. Nor is it the case that individuals have a pure incentive to coordinate or be accurate. Despite these facts, theoretical models show that players may still bias their strategies and attention towards public signals when there are gradations in actors' incentive to coordinate, and when there are gradations in the probability that a signal is public (Dewan and Myatt 2007; Myatt and Wallace 2012). Thus, the results here may also shed light on situations where information is not typically considered purely public or private. For example, experiments have shown that in players in coordination games may coordinate their actions by strictly adhering to leaders' advice about what action is best for both players (Dickson n.d.). Interestingly however, subjects’ beliefs about each action’s outcome completely follow leaders’ signals and ignore other factors, such as the fact that leaders in these games have an incentive to shade the truth towards their own preferred actions. One reason for this may be that the surface implications of leader's advice are highly public and obvious, while the implications of leaders’ incentives may be less obvious, and therefore less public. Similar to the results presented in this paper, individuals who
want to coordinate their actions may pay more attention to the more obvious and public
dimension of leaders’ advice.

**Methods and Materials**

**Subject Pool:** 397 subjects were recruited from the online labor market Amazon
Mechanical Turk for a show up fee of 0.75 USD, with the promise that they would have
the opportunity to win additional monetary bonuses on the order of 1 USD. This payment
is small compared to many laboratory studies, but actually large compared to many tasks
of comparable length. Studies with similar incentives have replicated the results of
numerous economic games where subjects were paid on the order of 10-20 USD(Rand
2012).

As several studies recommend (Mason and Suri n.d.; Paolacci, Chandler, and Ipeirotis
2010; Rand 2012), subjects were only eligible if they had 95% or more of their previous
tasks (called HIT’s) approved. Participation in the study was further restricted to be
residents of the United States. After the completion of the study subjects were asked to
voluntarily self report a number of demographics. Similar to previous studies that have
recruited participants from this subject pool, I find that on self-reported demographics
such as age, income, level of education, and ideology, subjects are more diverse than
university student populations used in many experimental studies (Berinsky, Huber, and
Lenz 2012; Paolacci, Chandler, and Ipeirotis 2010; Rand 2012).

**Assignment to Treatment** Eligible subjects, who signed into the task were forwarded to
a website for the experiment, which was administered using the web-based software
Qualtrics. At the time subjects signed up they were randomly assigned to either the Coordination condition or the Accuracy condition. These conditions varied only in the incentives players were given. Players were either paid 1 USD to state the same proportion of orange balls as another player, or paid 1 USD to correctly state the true proportion of balls in the jar.

**Instructions and Quiz** Full instructions are listed in the Supporting Information. Prior to participating in the study subjects had to correctly complete a quiz based on the instructions both to guarantee that they understood the rules of the game they were playing and to guarantee that they knew the player they were paired with also understood the instructions.

**Matching:** Subjects in both the Coordination and Accuracy conditions were matched eventually with another player, but each player completed the experiment asynchronously. Subsequent to participating in the study, subjects were randomly paired with another subject who had seen the same set of public signals (described in the main text), and paid according to their incentives.

**Bonus:** Subsequent to playing either the coordination game players were informed that they had an opportunity to win a surprise bonus of 1 USD. For players in the Coordination condition the bonus would be paid if they correctly stated the number of orange balls in the jar. This was to measure their belief about the proportion of balls that were orange. Subjects in the Accuracy condition were paid if they could state the same number of orange balls as the person they were paired with. This was to measure their ability to coordinate. Neither participant knew about these bonuses prior to observing
signals drawn from the jar. This was to make sure that subject’s learning was based solely on the original incentives described in the instructions at the start of the experiment.

**Demographics** Subsequent to the main experiment subjects were asked a series of demographics questions. These demographics are available upon request.
FIGURES AND TABLES
Figure 2.1 Example of a Coordination Game
Figure 2.2: Subjects in both the treatment and control condition observed two separate types of signals in the form of colored balls drawn from a jar with replacement. (A) Public signals were observed by both players and this was self-evident, such that each player would know that the other had seen the same signal (and vice-versa). (B) Other signals were private. They were drawn from the same jar, but only one player observed them (in this example P1). The other player (in this example P2) was informed that the other player had observed a private draw, but they did not know what color P1 had observed. Likewise P1 knew that P2 did not know which color they had observed.
Figure 2.3: Players in both the coordination and accuracy condition played a strategy, $P_{oi}$, that was linear in their public ($Public_{oi}$) and private ($Private_{oi}$) signals, placing a weight $\alpha$ on the former and $1-\alpha$ on the later. (A) As theoretically expected, subjects estimated alpha in the accuracy condition placed equal weight on both ($\alpha=.5$). Subjects in the coordination condition placed more weight on public signals than private signals ($\alpha=.61$), but this is less than the equilibrium value of 1. (B) In the coordination condition players’ beliefs about the true proportion of balls in the jar usually equal their strategy, suggesting that they paid more attention to the signals used in their strategy. To show overlapping observations, points are randomly jittered. (C) Mediation analysis confirms that is an average causal mediation effect (ACME), as the coordination incentive caused players to place more relative weight on public signals in the coordination game, it also moved their beliefs about the underlying distribution of signals in the same direction. (D) This extra attention to public signals may have however helped players, as subjects in the coordination condition, on average, earned more in their coordination game than control subjects did in a similar game.
Supporting Information

Proof that the unique linear equilibrium is $\alpha=1$ in the coordination condition and $\alpha=1/2$ in the accuracy condition.

Here I prove that the unique linear equilibrium for players in the coordination condition for each player $i$ is $\alpha_i=1$. In the accuracy condition it is for each player to play $\alpha_i=1/2$.

The proof below generally follows a similar proof given in Morris and Shin (2002). However, in order to fit the experiment, the proof makes a different assumption about the error structure of signals.

In the experiment, players see an equal number of public and private signals from a binomial distribution, $\theta$. First, assume that there linear equilibrium, such that each player $i$’s strategy is a linear function of his or her public and private signal.

\begin{equation}
    s_i = f(Public_o, Private_{oi}) = \alpha(Public_o) + (1-\alpha)(Private_{oi})
\end{equation}

Then player $i$’s expectation of player $j$’s strategy is.

\begin{equation}
    E_i(s_j) = \alpha(Public_o) + (1-\alpha)\left(\frac{Public_o + Private_{oi}}{2}\right)
\end{equation}

This follows from the fact that player $i$ knows the public signals that player $j$ saw, and the fact that player $i$’s best estimate of player $j$’s private signal is the average of player $i$’s public and private signal.

Player $i$’s best response is then to play:
\[ s_i = rE_i(s_j) + (1 - r)E_i(\theta) \]

\[ = r \left[ \left( \alpha Public_o + \frac{(1 - a) Public_o + Private_{ai}}{2} \right) \right] \]

\[ + (1 - r) \left( \frac{Public_o + Private_{ai}}{2} \right) \]

\[ = \left( \frac{r\alpha}{2} + \frac{1}{2} \right) Public_o + \left( \frac{1 - r\alpha}{2} \right) Private_{ai} \]

(3)

Here, \( r \) is a coefficient \( \in [0,1] \) determining the pay-off to coordination relative to accuracy. In the coordination condition, \( r=1 \). In the accuracy condition \( r=0 \)

Setting the coefficient in front of \( Public_o \) in eqn. 2 equal to the coefficient in front of \( Public_o \) in eqn. 1, I obtain:

\[ \alpha = \frac{r\alpha}{2} + \frac{1}{2} \]

\[ = \frac{1}{2 - r} \text{ for } r \neq 2 \]

Therefore in the coordination condition, where \( r=1 \), \( \alpha =1 \); and in the accuracy condition, where \( r=0 \), \( \alpha =1/2 \).

As the value of private information in the coordination condition is essentially 0 for equilibrium strategies, equilibrium players should not pay attention if there is any cost to attention. Players in the accuracy condition increase their chance of winning 1 MU by reducing the variance in their belief relative to the true state of the world. They should therefore pay attention to the nth signal whenever the cost of attention is less than

\[ \left( p(1 - p) \right) / n - \left( p(1 - p) \right) / (n+1) . \]
E. Estimation of average $\alpha$ used by subjects in the coordination and accuracy group

In the main text it is assumed that players announced the proportion of balls in the jar which were orange, $P_{oi}$, according to the linear strategy:

$$P_{oi} = \alpha(Public_{oi}) + (1-\alpha)(Private_{oi})$$

This can be rewritten as:

$$P_{oi} - Private_{oi} = \alpha(Public_{oi} - Private_{oi})$$

That is $\alpha$ denotes how much a player’s stated proportion deviates from his private signal relative to how much the public signal deviated from his private signal.

This parameter $\alpha$ was estimated separately for the control group and the treatment group using Huber regression. To establish that (P. J. Huber 1996) for the treatment group was statistically distinguishable from the estimate of $\alpha$ for the control group I ran the regression on the full sample, interacting $(Public_{oi} - Private_{oi})$ with a binary indicator Coordination, which was coded 1 if subjects were in the treatment group (coordination condition) and 0 if they were in the control group (accuracy condition).
Table 2.1: Estimation of Subjects’ Average Alpha Parameter

<table>
<thead>
<tr>
<th></th>
<th>Coordination Condition</th>
<th>Accuracy Condition</th>
<th>Full Sample + Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>((Public_o - Private_{\alpha}))</td>
<td>0.61*** (0.04)</td>
<td>0.50*** (0.03)</td>
<td>0.50*** (0.03)</td>
</tr>
<tr>
<td>Coordination</td>
<td></td>
<td></td>
<td>0.10 (0.18)</td>
</tr>
<tr>
<td>Coordination ×</td>
<td></td>
<td></td>
<td>0.11** (0.04)</td>
</tr>
<tr>
<td>((Public_o - Private_{\alpha}))</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>-0.03 (0.09)</td>
<td>-0.12 (0.07)</td>
<td>-0.13 (0.07)</td>
</tr>
<tr>
<td>N=181</td>
<td></td>
<td>N=216</td>
<td>N=397</td>
</tr>
</tbody>
</table>

* p<0.05, ** p <0.01, *** p<0.001

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Chapter Three
Money, Reputation, and Incumbency in U.S. House Elections, or Why Marginals Have Become More Expensive

Introduction

The traditional view in electoral research holds that Congressional election campaigns are principally aimed at highlighting the virtues of the individual candidates (Jacobson 1978). This is particularly important in the case of incumbents, who tend to be higher quality candidates and thus able to elicit greater affinity from the voters regardless of their party affiliation (Cover 1977; Jacobson 2009). This emphasis on the role of the individual rather than the party in Congressional elections is consistent with the once-dominant view that largely downplayed the significance of party reputations in shaping voter decisions (Mayhew 1974a; Stokes and Miller 1962).

More recent research, however, assigns a much greater electoral significance to the parties’ collective reputations. Numerous studies point to the presence and significance of partisan electoral tides (e.g. Clagget, Flanigan, Zingale 1984; Kawato 1987; Brady, D’Onofrio, and Fiorina 2000). Others have examined how partisan tides shape the strategies of different political actors (Jacobson and Kernell 1983), or how polarization in Congressional party politics drives electoral outcomes (Jones 2010). Various theories of Congressional parties are also motivated by the premise that the parties’ collective reputations have a significant electoral effect (Aldrich 1995; Cox and McCubbins 1993). The implication of these studies is that the personal characteristics of
candidates have come to exert a smaller influence on electoral outcomes relative to
the collective reputations of the parties (Jacobson 1998).

The increasing electoral significance of parties has been accompanied by an
underlying shift in the informativeness of parties’ collective reputations relative to the
reputations of individual legislators; and, voters today are far more aware of what the
parties stand for than they were in the past (Hetherington 2001). These findings fit
with the logic of studies in voting behavior, which argue that voters act as Bayesian
learner who uses the record of candidate’s party to form their prior beliefs about the
candidate himself (Bartels 2002, Bartels and Achen 2006, Grynaviski 2006, Green
and Gerber 1999). Greater intraparty homogeneity in legislative behavior makes
party labels more informative and provides voters with stronger priors about their
candidates (Snyder and Ting 2002). Consequently, the individual actions of
legislators have less influence in changing voters’ minds.

The increase in the informativeness of party labels has changed not only the
way voters view candidates, but also the pattern of effort that individual incumbents
in different electoral environments must put into campaigning. We argue that the
increasing importance of party reputations has significantly contributed to the patterns
of growth in campaign expenditures over the past four decades. The increase in
campaign spending has been particularly large in marginal districts where support for
the incumbent’s party is weak. This is because stronger party reputations have made
it much more expensive to court “marginal” voters who will not vote for the average
member of an incumbent’s party, but would choose the incumbent based on his individual record. Even though these voters would be willing to vote for the incumbent on the basis of his own legislative record, the party’s reputation increasingly dominates voters’ prior beliefs about him and makes it harder for the incumbent to efficiently communicate his record to voters.

In order to counter voters’ unfavorable prior beliefs about him, the incumbent must engage in additional campaigning, at a greater monetary expense. Additional campaigning serves to better inform voters about the incumbent’s more favorable record, and shifts voters away from their prior assumption that the incumbent is just like the rest of his party. Therefore, the earlier argument that incumbent spending is primarily aimed at informing voters about their own virtues, rather than their parties’ (Jacobson 1978, 2009) remains largely applicable. However, the stronger collective reputation of the parties demands that incumbents in marginal districts spend more to highlight the parts of their record that set them apart from their parties.

To derive testable hypotheses based on our argument, we develop a simple formal model that describes the joint effect of party and personal reputations on the campaign spending of congressional incumbents. We model each type of reputation as composed of two parts: substance and clarity, analogous to the mean and the variance in statistics. We show that these variables interact with one another to

1 Throughout the rest of this paper, we will use pronoun “he” to refer to the candidate and “she” to refer to the voter.
generate three main predictions. First and foremost, when a party has a clearer (or low-variance) reputation, incumbents who need to win over marginal voters must spend more. Second, a different relationship holds for the incumbents in safer districts, where a clearer party reputation is, at minimum, not unhelpful electorally and may even be more advantageous. Lastly, as party brands become clearer, incumbents in marginal districts find it increasingly costly to maintain a voting record that is too close to their party’s. The logic of this last point relies on a subtle, but important aspect of Bayesian inference, which we elaborate in the next section. We evaluate and find empirical support for each of these arguments based on electoral and campaign spending data for House elections from 1972 through 2008.

Taken together, these findings should change how scholars think about the role of party brands. Party brands are often treated as public goods that aid the electoral prospects of party members (Cox and McCubbins 1993, Aldrich 1995). By contrast, we show that part brands are simply externalities that help members in relatively safe districts, but can harm the electoral prospects of incumbents in more marginal districts. Both the positive and negative effects of the party’s brand become more intense as party brands become more precise. Not only do campaigns become more expensive for incumbents in marginal districts, but it also becomes more expensive for these incumbents to support the party brand by maintaining a record that is close to the voting record of their party. Both of these findings demand scholarly attention on the question of how and whether parties can compensate marginal incumbents for these increasing costs.
A Model of Reputations and Campaign Expenditures

Following a number of previous articles (Bartels 2002, Grynaviski 2006, Bartels and Achen 2006, Green and Gerber 1999), we model the manner in which voters respond to information about parties and incumbents as a Bayesian learning problem. We use the model to show how the reputation of the incumbent’s party affects voter’s prior beliefs about his record, and how this in turn affects how much an incumbent needs to spend in order to communicate his record to the voters in his district.

Based particularly on the model proposed by Bartels (2002), we model the reputations of both the party and the individual incumbent as probability distributions, specifically with the variance representing the uncertainty. In other words, the larger the variance is, the more uncertain the voter is of the party or the candidate’s location and thus less clear the reputation is.\(^2\)

The reputation of the incumbent party is assumed to be the voter’s prior belief about where the incumbent stands relative to the voter. This assumption is consistent with a substantial body of research in voting behavior, which observes that party affiliation of candidates constitutes a heuristic or “information shortcut” that often furnishes voters with useful information about the candidates themselves (Brady and Sniderman 1985, Popkin 1995, Snyder and Ting 2002). If the voter receives

\(^2\) For the sake of computational simplicity, we assume a normal distribution, although the model applies to any single-peaked distribution.
additional information about the incumbent, she updates her prior belief according to Bayes rule, and modifies her voting decision to reflect her posterior belief about whether the incumbent is sufficiently close to her ideal point. We assume that this belief is normally distributed with mean $m_i$, and variance $s_i^2$.

We model the new information provided by an incumbent’s campaign as being drawn from his own reputation (which we assume to be based on his legislative record), with the amount of the information made available depending on the amount of campaign expenditures. This assumption is consistent with work by Coleman and Manna (2000), who show that the more campaign expenditures an incumbent incurs, the more knowledgeable voters become about his own legislative record in the past. We assume that the incumbent is closer to the district median than his party. This is consistent with what Erikson and Wright (2008) have found. The incumbent’s personal reputation is assumed to be a normal distribution with the mean $x$ and the variance $s^2$.

Voters in our model evaluate the perceived position of the incumbent relative to the perceived location of his challenger. As challengers typically have no record to campaign on, we model the challenger’s reputation as simply being the reputation of the challenger’s party, which is distributed normally with mean $m_c$ and variance $s_c^2$. The assumption that the challenger does not run on an individual record is consistent with much of the empirical literature on Congressional campaigns (Jacobson 2009).
To keep the model tractable, we do not model the challenger’s spending decision. We therefore do not account for any indirect effect that parties’ reputations might have on incumbent spending through their effect on challenger spending. The existing literature suggests that challenger spending increases as a function of incumbent spending (and vice versa) (Erikson and Palfrey 2000). So, the most likely risk of this simplifying assumption is that we may be underestimating the effect of polarization on incumbent spending.³

The incumbent is, of course, campaigning in an attempt to win over the median voter in his district. In modeling the voter choice, we assume a standard unidimensional policy space. We label a district’s median voter V and assume that she is located somewhere between the mean locations of the incumbent’s party’s and the challenger’s party. In any given election, the outcome is a function only of the relative distance between the perceived locations of the candidates. This allows us to simplify the model by assuming that the incumbent’s party is located at 0 and the

³ In the empirical section of this paper we account for challenger spending by making the standard assumption that incumbent spending increases linearly in challenger spending (Erikson and Palfrey 2000). We also show in the Online Appendix that in districts where challenger spending is exogenous to incumbent spending, incumbent spending becomes less effective over time. This is consistent with what our model predicts.
challenger’s party is at 1, i.e. \( m_i = 0 \) and \( m_c = 1 \), without loss of generality. This also has the useful consequence of allowing \( V \) to be interpreted as the district’s partisanship, or the degree to which the district leans towards the challenger’s party relative to the incumbent’s.

The basic model is shown in the Figure 1 below.

Campaigning consists of the incumbent drawing the voter’s attention to his record, which we model as the voter observing random draws from the distribution of the incumbent’s individual reputation\(^4\). This means that, after a single draw, the posterior belief of the voter regarding the position of the incumbent is characterized by a normal distribution with the following expected mean and variance.

\[
1) \quad (\mu_1 | n = 1) = \frac{\mu}{\sigma^2 (\frac{1}{\sigma^2} + \frac{1}{\sigma_x^2})}
\]

\[
\sigma^2_1 = \frac{1}{\frac{1}{\sigma^2} + \frac{1}{\sigma_x^2}}
\]

\(^4\) The assumption that draws from an incumbent’s record are random may be unrealistic because incumbents should want to highlight the most favorable information about themselves. However, this simplification is unlikely to fundamentally bias the model’s conclusions. For instance, if we assume that incumbents only take draws from the half of their record that is closest to the voter then it is easy to show that none of the model’s conclusions change qualitatively.
Campaigning costs the incumbent money. We model this as the incumbent paying for each observation drawn from the distribution that characterizes his own reputation, $N(x, s^2)$. Let $n$ be the number of draws from this distribution, so that a higher $n$ represents greater campaign expenditures. The voter observes these draws and updates her belief accordingly. After $n$ draws, $m_n$, the perceived location of the candidate, is characterized by a normal distribution with the following expected mean and variance:

$$ E[(\mu_n|n)] = \frac{nx}{\sigma^2 (\frac{1}{s_l^2} + \frac{1}{\sigma^2})} $$

$$ s_n^2 = \frac{1}{\frac{1}{s_l^2} + \frac{n}{\sigma^2}} $$

The median voter chooses the incumbent only if the utility she expects to obtain from voting for him is greater than that of voting for the challenger. For the sake of simplicity, we assume that the voter utility depends linearly on the distance between her ideal point and the perceived locations of the respective candidates.\(^5\)

In order to account for the possibility that voters may be sensitive to uncertainty, we incorporate the term $-\frac{\lambda}{2}s^2$ (where $s^2$ is the appropriate variance) in the utility function as a measure of risk aversion (where $\lambda$ is the Arrow-Pratt index of

\(^5\) We have opted for the simplest form of the utility function as its specific form has no substantive effect on our results as long as it is monotonic.
absolute risk aversion). Risk aversion means that greater uncertainty in a candidate’s location lowers the voter’s utility independent of any other factor. As $l$ approaches 0, the voter becomes risk neutral and the voter only cares about the distance between an incumbent and herself. For $l > 0$ voters prefer candidates with records that they perceive as being less variable.⁶

$$s^2 = \frac{1}{\frac{1}{s^2_l} + \frac{\mu^2}{\sigma^2}}$$

Since $s^2 = \frac{1}{\frac{1}{s^2_l} + \frac{\mu^2}{\sigma^2}}$ for the incumbent after n draws and since the challenger is assumed to have no personal reputation of his own, accounting for risk aversion requires inclusion of the terms $\frac{-l}{2\left(\frac{1}{s^2_l} + \frac{\mu^2}{\sigma^2}\right)}$ and $\frac{-\lambda s^2}{2}$ to the utilities of voting for incumbent and challenger, respectively. Thus, expected utilities of voting for the

⁶ We allow voters to be risk averse in order to make our model more comparable to previous models of party brands, such as that of Snyder and Ting (2002) as well as Woon and Pope (2008). These models show that risk aversion makes voters more tolerant of parties that are spatially distant from them if the party has a clearer reputation. Our model indicates that while risk aversion may make voters willing to vote for a party that is further away from them, it only helps out very specific subset of incumbents--those in districts that are relatively safe. There remain districts whose voters, regardless of risk aversion, will find the party to be too distant. Incumbents in these districts will have a harder time being reelected when party brands are clearer, and will have to spend more to make their more favorable individual brand shine through.
incumbent and the challenger by the district median voter located at $V$ after $n$ draws are given by the following:

3) $EU_i = -V + \frac{nx}{\sigma^2(\frac{1}{x_i} + \frac{n}{\sigma^2})} - \frac{\lambda}{2(\frac{1}{x_i} + \frac{n}{\sigma^2})}$

$EU_c = -(1 - V) - \frac{\lambda x^2}{2}$

Because the challenger’s perceived location is same as that of his party, at $m_c = 1$, the challenger’s distance from the median voter is simply given by $(1-V)$. The distance to the incumbent’s party at $m_i = 0$ is given by $V$. However, unlike the challenger, who has no record, the incumbent can move his perceived location closer to his own record through campaigning at the expense $n$, which is captured by $\frac{nx}{\sigma^2(\frac{1}{x_i} + \frac{n}{\sigma^2})}$.

Because the challenger lacks an individual record, the only penalty posed by his party’s collective reputation is captured by the voter’s risk aversion $\left(\frac{-\lambda x^2}{2}\right)$. For the incumbent, however, voter utility depends on the combination of uncertainties in both his own reputation and his party’s, captured by the term $\frac{-\lambda}{2(\frac{1}{x_i} + \frac{n}{\sigma^2})}$.

Given the substantial costs that an incumbent must incur for fundraising, in terms of time, policy compromises, and potential bad publicity (Baron 1989; Erikson and Palfrey 2000), we expect that the incumbent would seek to minimize campaign expenditure whenever possible. The winning condition for the incumbent is therefore
given by the median voter, located at $V$, gaining greater utility from voting for the incumbent rather than the challenger, i.e., $EU_i > EU_c$, which leads to the following inequality:

$$4) \quad -V + \frac{n x}{\sigma^2 (\frac{1}{s_1^2} + \frac{n}{\sigma^2})} - \frac{\lambda}{2(\frac{1}{s_1^2} + \frac{n}{\sigma^2})} \geq -(1 - V) - \frac{\lambda s_c^2}{2}$$

Because the left hand side of the Inequality 4 is linear in $n$, we need only to rearrange the terms and solve for $n$ to find the minimum requisite campaign expenditure, $\pi$. Solving this inequality for $n$ provides the minimum number of draws that the incumbent needs to pay for from his own distribution to secure reelection, which is equivalently to the minimum value that the incumbents’ spending needs to exceed in order to secure reelection, which is given by the following \footnote{If the district is sufficiently friendly to the incumbent’s party, indicated by a very small value of $V$, the equation implies a negative value of $\pi$. This becomes especially apparent if risk neutrality is assumed, i.e., $\lambda=0$, which simplifies the equation to $\pi = \frac{\sigma^2 (2V-1)}{s_1^2 (x+1-2V)}$, which is negative for $V<1/2$. Since a negative campaign spending cannot realistically take place, we impose the minimum campaign spending of 0.}.

$$5) \quad n \geq \pi = \max \left[ \frac{\sigma^2 (2V-1 - \frac{\lambda s_c^2}{2}) + \frac{\lambda s_c^2}{2}}{(x+1-2V+\frac{\lambda s_c^2}{2})}, 0 \right]$$
Having defined how an incumbent decides to spend money, we now define the conditions under which the reputation of the incumbent’s party is harmful (increasing how much the incumbent has to spend) or helpful (decreasing the amount an incumbent must spend). Let us define a positive parameter $K = \frac{1}{2} (1 + \lambda s_c^2)$. This permits us to rewrite Equation 5 as follows:

$$\bar{\pi} = \max \left[ \frac{2 \sigma^2 (v-K) + \lambda s_c^2}{s_1^2 (x+2(K-v))}, 0 \right]$$

In effect, $K$ allows us to distinguish between the “marginal” and “incumbent-party friendly” districts, while accounting for effects of voter risk aversion.\(^8\) A district

\(^8\) K is always positive since $l$ is positive by definition and $s_c^2$ is the variance of the challenger’s party, which, again, must always be positive. In fact, $K \geq \frac{1}{2}$, with equality only if $l = 0$

\(^9\) Introduction of the parameter $K$ may raise the question as to how the challenger’s party reputation might shape an incumbent’s campaign expenditure. Our model shows that, if voters are risk averse, a clearer reputation on the part of the challenger’s party would increase the campaign expenditure required of the incumbent. Incidentally, this provides the theoretical explanation for the empirical findings by Woon and Pope (2008) that a clearer party reputation aids the electoral prospects of its challengers, but not its incumbents. However, this effect applies everywhere independent of the district characteristics. As we are focused on
is marginal if the support for the incumbent’s party is relatively small, compared to
that for the challenger’s party. On the other hand, it is “incumbent-party friendly” if
the incumbent’s party enjoys a strong electoral support. In terms of the spatial model,
the marginality of the district depends on the relative distances between the median
voter and the respective parties. As we have fixed the incumbent’s party’s location at
0 and the challenger’s party’s location at 1 for the purposes of our model, district
marginality is simply defined by the location of the median voter, or V. Thus, a
district is more marginal if the value of V is large, while it is less marginal—and
more incumbent-party friendly—if it is small. For our purposes, we define a district
as marginal if V > K and incumbent-party friendly if V < K.

In practice, the campaign expenditures by incumbents are also impacted by
additional factors outside of our simple model. Spending may depend on factors
particular to a given district or to the national circumstances under which the election
takes place. We capture this by incorporating a noise term \( C_i(t) \) which has a positive
nonzero mean that varies both across time t and across districts i within given any

examining how effects of party reputations vary across different types of districts, this
question is not pertinent to our paper. As the challenger’s party reputation is both
constant for each year (for all members of the same party) and there is no predicted
interaction with district characteristics, we deal with this effect empirically by using a
set of fixed effects, as described in more detail below.
period, but is orthogonal to the parameters characterizing both party and candidate reputations. The revised expression for $\bar{n}$ then becomes:

\[
7) \quad \bar{n} = \max \left[ \frac{2\sigma^2(V-K) + \lambda \sigma^2}{\frac{1}{2} s_i^2}, 0 \right] + C_i(t)
\]

We can now derive and prove two main propositions about how the incumbent’s campaign spending is affected by the interaction between his own party’s collective reputation and his district’s characteristics.\(^{10}\)

**Proposition 1:**

*An incumbent’s campaign expenses decreases in marginal districts and increases in incumbent-party friendly districts as the variance of his party reputation becomes larger (i.e. becomes less clear).*

**Proof:**

We can show this simply by differentiating Equation 7 with respect to $s_i^2$, the variance of the party reputation, which yields the following.

\[
8) \quad \frac{\partial \bar{n}}{\partial s_i^2} = \frac{-2\sigma^2(V-K)}{s_i^4 \left[ x + 2(K-V) \right]}
\]

\(^{10}\) The incumbent’s spending is also shaped by the uncertainty in his own personal reputation, which affects his ability to successfully disassociate himself from his own party. As this effect, however, is less central to our argument and measurement of uncertainty in personal reputation of incumbents is potentially difficult, we address this separately in the Appendix.
The parameters \( s^2 \) and \( x \) are the variance of the incumbent’s personal reputation and the distance between his own position relative to his party’s, respectively. As such, these are always positive and do not affect the sign of the derivative. Indeed, the sign of the derivative depends only on the district’s marginality: the derivative becomes positive if \( V<K \), i.e. the district is incumbent-party friendly; it is negative, on the other hand, if \( V>K \), or if the district is marginal.\(^{11}\)

Our argument, that higher uncertainty in party reputation leads to an electoral advantage in a marginal districts, might appear to be at odds with some of the existing literature, most notably Shepsle (1972), who suggests that candidates might be harmed by higher uncertainty in their perceived position if voters are risk averse. It is not. In the existing literature, voters are aware of the distribution of incumbent’s own positions and evaluate him accordingly. In our model, voters are initially cognizant only of the incumbent’s party reputation and the incumbent sometimes aims to persuade the voters that he is different from his party by providing new information through campaigning. Viewed through this lens, greater uncertainty in party reputation becomes an advantage only when the party reputation is harmful compared to the incumbent’s personal reputation. In the incumbent-party friendly districts,\(^{11}\) this derivative becomes negative again if \( V>K+\frac{x}{2} \). We can exclude the third case from consideration, however, because that represents the subset of cases where the district’s median voter is located so close to the challenger’s party that the incumbent cannot win her over even with his true position as an individual fully revealed.
however, higher levels of uncertainty in party reputation do affect an incumbent’s prospects negatively precisely because of voters’ risk aversion.

Equation 8 shows further that for a given change in the value of $s_i^2$, the magnitude of the change in campaign expenditures is directly correlated with the measure of district marginality, $(V-K)$. In other words, in very marginal districts, a higher variance in the incumbent’s party reputation decreases spending a lot; while in less marginal districts, a higher variance in the incumbent’s party reputation only decreases spending a little. Likewise, in districts that are very incumbent-party friendly, a higher variance in the incumbent’s party reputation increases spending a lot; while in less incumbent-party friendly districts, a higher variance in the incumbent’s party reputation only increases spending a little. This implies the following corollary to Proposition 1.

Corollary 1:

*The effect-size of variance in the incumbent’s party reputation depends on how marginal or party-safe the district is. Variance in the incumbent’s party reputation increases spending more when the district is more marginal. It decreases spending more when the district is more incumbent-party friendly.*

Our model also implies a relationship between an incumbent’s campaign spending and the distance between his own position and his party.

**Proposition 2:**

*As the incumbent’s position becomes closer to his party’s, his campaign expenditures will increase in marginal districts and decrease in incumbent-party friendly districts.*

**Proof:**
To examine how the candidate’s distance from the party affects their spending, we differentiate $\bar{n}$ with respect to $x$, the distance between the incumbent’s party’s location and his own:

$$9) \quad \frac{\partial \bar{n}}{\partial x} = \frac{-\frac{2}{s_1^2} (\lambda/\lambda + \frac{\lambda s_1^2}{2})}{[x+2(K-V)]^2}$$

The sign of the derivative $\frac{\partial \bar{n}}{\partial x}$ depends, again, on the marginality of the districts. If the district is marginal, i.e. $V > K$, then this derivative is negative. A decrease in the value of $x$, the distance between the party and the candidate, leads to an increase in the value of $\bar{n}$ $\bar{n}$. Therefore, in marginal districts, moving toward the party (and by assumption, away from the voter) always makes it more expensive for an incumbent to highlight his own record. On the other hand, in a safe district, i.e. $V<K$, the derivative is positive, implying that the incumbent could decrease their spending by moving closer to the party.

Proposition 2 has an additional implication. Observe that the magnitude of the derivative $\frac{\partial \bar{n}}{\partial x}$ increases as the uncertainty of the party reputation, $s_1^2$, decreases. This means that, as the party reputation becomes clearer over time, adhering to the party more closely leads to even greater spending increases in marginal districts.\(^{12}\)

\(^{12}\) The same logic suggests that adhering closer to the party’s position will also lead to even greater spending reductions in incumbent party friendly districts, but we expect the effect to be stronger in marginal districts as incumbents in incumbent-party
The intuition for this follows from the logic of base-rates in Bayesian reasoning. If voters already think it is highly probable that an incumbent is like the mean of his party, confirmatory evidence will be seen as more diagnostic. Therefore, voters will attach more weight to such evidence, and it will take even more campaigning to show how the candidate is different from other partisans. This leads to the following corollary:

**Corollary 2:**

*An incumbent’s distance from his party has a greater effect on the incumbent’s spending when his party’s reputation becomes clearer.*

**Empirical Evaluation of the Model**

Our dependent variable is the inflation adjusted campaign expenditures incurred by an incumbent in a House election, which we posit, reflects the effort of incumbents to inform voters about their own record (Jacobson 1978, 2009, Coleman and Manna 2000). Our formal model leads to two major predictions and two

friendly districts have less incentive to bear the cost of highlighting their own record when the record of their party is already popular. This implies that the overall effect of adhering closer to the party is likely to be dominated by the effect in marginal districts, where it increases campaign costs. In other words, the net effect of being too close to the party is likely to be positive, or, equivalently, the net effect of the distance between an incumbent and his party is likely to be negative, as we indeed find empirically.
subsidiary predictions concerning how changes in an incumbent’s party reputation shape his campaign spending.\textsuperscript{13}

1. First, \textbf{Proposition 1} indicates that the change in clarity of an incumbent’s party reputation has opposite effects on his campaign expenditure depending on the marginality of his district: if he is in an incumbent-party friendly district, it decreases; if he is in a marginal district, it increases. The magnitude of this effect, in turn, depends on how marginal the district is, as indicated by \textbf{Corollary 1}.

2. Second, \textbf{Proposition 2} shows that the distance between an incumbent’s and his party’s locations have different effects depending on the clarity of the party reputation. First, in marginal districts, the clearer the party reputation is, the more an incumbent needs to spend for being closer to his party. Second, in

\textsuperscript{13} The model actually makes a third prediction. The ease with which an incumbent can highlight distinctiveness of his personal record depends on its clarity: if an incumbent has behaved consistently in the past, it is easier for him to show that he is different from party. However, this is a relatively minor implication that merely complements \textbf{Proposition 2} and we feel that too extensive a discussion of this topic distracts from our main argument, that changes in party reputation has starkly different implications in different types of districts. As such, we leave the discussion of this topic to the Appendix.
incumbent-party friendly districts, the clearer the party reputation is, the less an incumbent needs to spend for being closer to his party.

In testing these hypotheses, we recognize that the political reputations of both individual legislators and parties are products of many sources that, most likely, cannot be accounted for in full. However, we follow the argument offered by Cox and McCubbins (1993; 2007) and Woon and Pope (2008) that a large proportion of these reputations is the product of various legislative activities that take place on record within Congress. The widely used DW-Nominate scores capture one important set of these reputation-shaping intralegislative activities: aggregate patterns of roll call votes cast by legislators (Poole and Rosenthal 2000). Therefore, we operationalize the pertinent reputations using the DW-Nominate scores as follows:

**Party Reputation and District Characteristics**

In our formal model, we have normalized a median voter V’s distance from the incumbent’s party and the challenger’s party to be between 0 and 1. We can therefore use a measure of district’s partisanship to capture each district’s normalized distance from each party. As the presidential vote-share of the incumbent’s party in the most recent presidential election has been frequently used as a reasonable measure of a district’s affinity for the national party brand (e.g. Canes-Wrone et al 2002), we use this variable to capture District Partisanship for the incumbent’s party in a given district. The larger the presidential vote share, the closer the district median is to the incumbent’s party. In our formal model, a district’s marginality decreases
monotonically as the district median, \( V \), moves closer to the incumbent’s party. Therefore, \textit{District Partisanship} serves as a measure of a district’s marginality. As \textit{District Partisanship} increases a district becomes less marginal.

\textbf{Proposition 1} holds that the effect of \textit{District Partisanship} on incumbent spending depends on the variance of his party’s reputation. To measure this, we use the standard deviation of a party’s DW-Nominate scores, which we label \textit{Uncertainty in Party Reputation}. This measure captures the amount of dispersion, or “spread,” among party members’ collective voting records, and is directly related to how predictable a legislator’s behavior will be given his party label. It therefore fits our concept of reputational uncertainty. A larger standard deviation in the party’s DW-Nominate scores indicates that the party reputation is more variable and less clear.

\textbf{Corollary 1 to Proposition 1} shows that the effect of variance in a party’s reputation varies continuously with a district’s marginality. We expect to see the variance in a party’s reputation decrease spending the most in the most marginal districts, and also expect this effect to attenuate as districts become less marginal (with the effect size possibly crossing zero and leading to positive spending in the most incumbent-party friendly districts). We capture this effect with a continuous interaction between \textit{Uncertainty in Party Reputation} and \textit{District Partisanship}.

\textbf{Individual Reputation}

\textbf{Proposition 2} shows that an incumbent’s campaign expenditures depend on the distance of their individual reputation from their party’s. We capture this through
distance between an incumbent’s 1st dimensional DW-Nominate score and their party’s mean DW-Nominate scores in each Congress prior to the election, which we label Incumbent-Party Distance.

The effect-size of an incumbent’s distance from his party depends on both the district’s marginality, as noted in Proposition 2, and on the uncertainty in his party’s reputation. We capture these through two interactions. We interact Incumbent-Party Distance with District Partisanship to capture the dependence of Incumbent-Party Distance on the district’s marginality. To account for the dependence of Incumbent-Party Distance’s effect on Uncertainty in Party Reputation, we interact these variables.

**Empirical Model**

The baseline statistical model we use to evaluate our hypotheses is an ordinary least squares regression of the following form (with variables listed in the same order as the hypotheses they test):

Incumbent’s Campaign Expenditures

\[ = b_0 + b_1 \text{ (Uncertainty in Party Reputation)}
+ b_2 \text{ (District Partisanship)}
+ b_3 \text{ (District Partisanship} \times \text{Uncertainty in Party Reputation)}
+ b_4 \text{ (Incumbent-Party Distance)}
+ b_5 \text{ (Incumbent-Party Distance} \times \text{Uncertainty in Party Reputation)}
+ b_6 \text{ (Incumbent-Party Distance} \times \text{District Partisanship)} \]
We also include the following control variables to capture factors that are known to shape Congressional elections and campaign expenditure strategies:

1) **Challenger’s Campaign Expenditure**: Existing research (e.g. Erikson and Wright 1993; Erikson and Palfrey 2000; Jacobson 2009) indicates that the more challenger spends, the better he does. An incumbent facing a lavishly spending challenger thus needs to spend more himself to thwart electoral danger. To account for this, we include the expenditure incurred by the challenger in the fully-specified statistical model.

2) **Challenger Quality**: An incumbent’s electoral prospects are known to become more difficult when facing challenger who has previously won an elected position (Jacobson and Kernell 1983). To account for this, we include a dummy variable taking the value of 1 when the challenger has held an elected office previously and 0 otherwise.\(^{14}\)

3) **Freshman**: First-time incumbents often enjoy comparatively less political influence than the more established ones. This is due to, among other reasons, the fact that a new incumbent has fewer opportunities to perform electorally useful activities (Mayhew 1974b) or less access to influential committee assignments (Munger 1988). To account for this, we include a dummy

\(^{14}\) In effect, we assume an arbitrary “jump” by a quality challenger towards the median voter in a district, away from his party, in the spatial model. We investigate the challenger’s problem in greater detail in another paper.
variable that takes the value of 1 if it is the first time that the incumbent faces a reelection and 0 otherwise.

All the electoral and campaign finance data that we use have been collected and generously provided by Gary Jacobson. DW-Nominate and associated data have been obtained from Keith Poole and Howard Rosenthal’s website (http://www.voteview.com). All our measures of incumbent and challenger spending have been appropriately adjusted for inflation, using 1983 as the baseline year.

Campaign expenditures are, as we noted earlier, potentially affected by numerous factors particular to the district or year. In our formal model, we incorporate this through the term \( C_i(t) \). To help account for these unmeasured differences, we employ a two-way fixed effects model with district and year fixed effects.\(^{15}\) In order to address the changes in district lines due to redistricting, we code post-redistricting districts as separate from the old districts with the same number. By including district fixed effects, we account for any mean variation in a district that accounts for incumbent’s mean level of spending. Year fixed-effects allow us to control for mean levels of spending in any given year, which may be the product of various political events, such as presidential popularity and economic performance.

\(^{15}\) For speed and convenience our replication file fits this model using an algorithm developed by Cornelissen (2008) for estimating models with high dimensional fixed-effects. However, we have also fit our model using the slower method of including dummies for each variable. There is no difference between these estimates.
Year fixed-effects also control for any systematic time trends that may drive mean campaign expenditures.

Results

Estimating the full model raises concerns about multicollinearity, as it includes three interactions of continuous variables. To allay such concerns, we run three separate models that include only one interaction each. We then fit the full model including all three interaction terms, noting that compared to our estimates of the same interaction terms in the first 3 models, this has almost no impact on coefficients’ sign, size, or significance.

Table 1 below shows the results of our statistical analysis using Liang and Zeger (1986) standard errors clustered by district.\textsuperscript{16} The first three columns show the

\begin{table}
\centering
\begin{tabular}{|c|c|c|c|c|}
\hline
Variable & Estimate & Standard Error & p-value & \hline
\hline
Interaction 1 & 0.123 & 0.056 & 0.043 & \\
Interaction 2 & 0.234 & 0.078 & 0.005 & \\
Interaction 3 & 0.345 & 0.099 & 0.001 & \\
\hline
\end{tabular}
\caption{Statistical Analysis Results}
\end{table}

\textsuperscript{16} Clustering the standard errors by district helps account for any residual autocorrelation that may still exist between district-years after controlling for the mean level of spending in a district, which is a commonly overlooked but real problem in two-way fixed effects models (Angrist and Pischke 2009 p. 315-319, Bertrand et al. 2004). We cluster the standard errors at the district level and not the candidate level because it is more conservative to assume errors are correlated within districts, and, controlling for other variables, are independent between districts. However, we have also estimated our model with the errors clustered by candidate. Doing so does not change any of our results.
results of the regressions using a single interaction term each. The first column shows the interaction between the uncertainty in the incumbent’s party’s reputation and district partisanship. The second shows the interaction between an individual candidate’s distance from his party and uncertainty in the incumbent’s party’s reputation. The third column shows the interaction between an individual candidate’s distance from his party and district partisanship.

We evaluate the implication of the **Proposition 1** via the first 3 variables in our model (*Uncertainty in the Party Reputation, District Partisanship*, and the interaction between these variables). The estimated coefficients for these variables are shown in the first 3 rows of columns 1 and 4 of Table 1.

We have argued that greater uncertainty in party reputation decreases spending in marginal districts and possibly increases spending in incumbent-party friendly districts. Specifically, an increase in the uncertainty of an incumbent’s party reputation should decrease spending the most in the most marginal districts. In column 1 (and 4) the coefficient on *Uncertainty in Party Reputation* represents the effect of uncertainty in a party’s reputation when the district is the most marginal (that is, when *District Partisanship* is 0). This is because these terms are also interacted (Braumoeller 2004). We therefore expect the coefficient of *Uncertainty in Party Reputation* to be very negative and statistically significant, which it is.

We have argued, via **Corollary 1**, that that the effect of uncertainty in a party’s reputation on campaign spending should attenuate as a district becomes less
marginal, as party bolstering personal reputation of the incumbent via individualized campaigning becomes both less effective and less necessary when voters rely more on party labels. The greatest reduction in campaign expenditures should take place in the most marginal districts, while the least reduction (and possibly, the greatest increase) in campaign spending should take place in the most incumbent-party friendly districts. This is shown through the positive coefficient on District Partisanship × Uncertainty in Party Reputation. To make the interaction more interpretable, we plot in Figure 2 below the estimated marginal effect of Uncertainty in Party Reputation on spending as a function the District Partisanship. Dashed lines represent 95% confidence intervals of the estimated effect.

Figure 2 shows that the effect of the greater uncertainty in incumbent party’s reputation on campaign spending attenuates as districts become less marginal. Indeed, a greater uncertainty in party reputation seems to actually increase spending in incumbent-party friendly districts. Given the uncertainty in our estimation, we cannot say precisely where the sign of the effect changes. However our best estimate is that the transition from a negative to positive effect occurs when the presidential vote share of an incumbent’s party is around 55%. Interestingly, 55% is almost exactly the median value in district partisanship among the incumbents in our sample. We therefore speculate that a greater uncertainty in party reputation is potentially harmful to roughly half of a party’s incumbents, forcing them to spend more on their campaigns, but helpful to the other half, reducing their need to incur campaign expenditures.
We have argued, in Proposition 2, that an incumbent’s campaign spending needs depend on the distance between his personal reputation and that of his party. In marginal districts, a greater distance makes it easier for the incumbent to distinguish himself from his party and show that he is closer to his district. The more marginal the district is, furthermore, the greater the savings due to the Incumbent-Party Distance should be. In incumbent-party friendly districts, on the other hand, such disassociation between the incumbent and his party is likely to be unhelpful, especially as the district becomes more incumbent-party friendly. As incumbents are not likely to engage in behavior that will disadvantage them electorally, we suspect that most incumbents who distance themselves from the party are likely to do so in relatively more marginal districts (as indeed has been found by Erikson and Wright (2008)). Consequently, the net effect of the distance would be to reduce campaign spending. This is borne out, as the coefficient on the variable Incumbent-Party Distance is negative and significant.

A fuller examination of the relationship between an incumbent’s personal and party reputations requires interacting the Incumbent-Party Distance and District Partisanship. This interaction is included in columns 2 and 4 of Table 1. We also illustrate this interaction by plotting the marginal effects of an Incumbent-Party Distance on campaign expenditures as a function of District Partisanship in Figure 3 below.
As expected, the benefits of disassociating from the party decrease as the district partisanship becomes more favorable to the incumbent’s party. The effect of distancing oneself from the party is only significantly different from 0 in districts where the vote share of the incumbent’s presidential candidate is less than 60%.

**Proposition 2** further implies, as we have noted via **Corollary 2**, that the effect of the *Incumbent-Party Distance* is magnified by a smaller uncertainty in his party’s reputation: In marginal districts, the cost of being close to one’s party is greater when the party reputation is clearer. In incumbent-party friendly districts, the cost of being further to one’s party is greater when the party reputation is clearer. We test this by interacting *Incumbent-Party Distance* and *Uncertainty in Party Reputation*, as shown in Columns 3 and 4 of Table 1. We further illustrate this via Figure 4, showing the marginal effects of *Incumbent-Party Distance* on campaign expenditures as a function of *Uncertainty in Party Reputation*.

Figure 4 shows an interesting trend in incumbents’ incentive to disassociate from their party. The trend in party reputations in recent years, as measured in Congressional voting records, has been largely monotonic, with the standard deviations of both parties’ DW-Nominate scores almost constantly moving downward. During the period of our study, the standard deviation of the DW-Nominate scores for the House Democrats fell from 0.21 to 0.15. During the same time, the standard deviation of the DW-Nominate scores House Republicans fell from 0.19 to 0.15. Figure 4 indicates that the electoral benefit (as measured in savings in
campaign expenditures) of deviating from the party was not statistically
distinguishable from 0 when the party’s collective reputation was most uncertain.
Distancing oneself from the party helps reduce incumbents’ spending only when
parties become sufficiently unified in their voting behavior. In terms of spending,
only when parties’ reputations became meaningful enough to voters do incumbents in
more marginal districts find deviating from the party worthwhile.

Discussion

Numerous scholars have argued that Congressional elections take place in the
shadow of the parties’ collective reputations (Campbell et al 1960; Popkin 1995;
Snyder and Ting 2002; Cox and McCubbins 1993). This is because the party
reputation can substantially affect how voters view individual candidates, and can
even take precedence over an incumbent’s own reputation if the party brand is
informative enough. A strong and informative party label means that candidates
increasingly face voters who view them as a typical partisan, and whose minds are
harder to change on this front. Facing such voters, candidates are left with two
possible choices: they may redouble their own personal effort to disseminate
information about themselves, or resign themselves to the relative anonymity of being
seen as a mere partisan.

Running as a typical partisan in an incumbent-party friendly district does not
represent a special hardship. However, such a strategy is unlikely to yield success in
marginal districts. If the party label alone does not suffice to ensure electoral success,
the candidate is forced to campaign as an individual, predominantly focusing on his own individual merits and relying on his own resources. As Jacobson (1978, p. 485) observed: “campaign spending is important to candidates who need to make themselves known to voters.” (emphasis added). As our results indicate, directing voters’ attention to the person of the candidate and away from the party is complicated by a stronger party reputation.  

Our findings are consistent with previous arguments that both the reputations of the party and its individual members are strongly shaped by their legislative activities, and that these reputations have significant electoral consequences (Cox and McCubbins 1993; 2007; Woon and Pope 2008). Intraparty homogeneity in the legislative process shapes elections by shaping the information available to the voters (Aldrich 1995). By providing reliable information about most incumbents, stronger party reputations de-personalize elections, encouraging voters to ignore individual candidates and their reputations. Candidates with distinct and consistent legislative reputations of their own would be affected less by the weight of stronger party reputations, but as parties have grown more homogeneous, such candidates have grown fewer in numbers.

Note that we are not necessarily claiming that the candidates are claiming that they are opposed to their party, but only that they, individually, have characteristics that might be viewed more favorably by the voters. Such characteristics may be completely orthogonal to the presumed reputation of their party.
While we do not dispute the argument that collective party reputations play an important role in shaping the outcome of Congressional elections, we are more skeptical of the claim that strengthening the party’s reputation constitutes a public good that confers a net electoral benefit on all members, and that parties exist principally for the purpose of proactively building and maintaining a precise reputation (Aldrich 1995; Cox and McCubbins 1993). Our findings show that a clearer, stronger party reputation does not uniformly benefit all party members. While a clearer party reputation may prove an electoral boon to the incumbents in incumbent-party friendly districts, it turns the electoral environment in marginal districts toxic.

In terms of its aggregate electoral impact, a stronger party reputation may not even serve the interests of the party as a whole. By assisting in the electoral defeats of incumbents in marginal districts, or, at least making their reelection bids more difficult, a stronger party reputation might actually weaken a majority party’s hold on its status in the chamber. In this vein, our findings place into context Mayhew’s famous suggestion that the best service a Congressional party can provide for its incumbents is to leave them alone, so that they may carve out their own unique reputation to fit their districts (1974a, p. 100). In districts where the party is not especially well liked, the personal reputation of the incumbent, not the party, offers the best path to electoral success. However, a stronger party reputation gets in the way by crowding out the role of individuals and driving up the cost of campaigning.
From the perspective of the party on the whole, this can be particularly dangerous because a clearer party reputation is divisive in a way that a weak party reputation is not. A strong party reputation accentuates internal divisions within the party, as it confers both greater rewards and stiffer penalties for different subsets of party members, giving each side even more of an incentive to fight. While the incumbents in incumbent-party friendly districts may have gained, they did so by alienating their colleagues in marginal districts, possibly poisoning prospects for cooperation within the party framework in Congress. In this vein, our argument may provide some explanation for the “ends against the middle” voting that has been seen more in recent congresses.

Why, then, did the Congressional politics of 1970s and 1980s begin the trend towards stronger party reputations that we see today, as observed by Rohde (1991)? We suggest that the contrast between the patterns of campaign expenditures in 1972 and 2008 provides at least a partial answer. Even a moderate and weak party reputation is still a reputation: it still provides the backdrop that helps and hinders the electoral efforts by party candidates of different stripes. The weak reputations of the parties in the early 1970s offered no significant electoral benefit to the candidates running in highly partisan districts. The later development of stronger party reputations did, but only by shifting the burden to their intraparty rivals representing marginal districts. Thus, the changing nature of party politics in Congress in the past several decades may have been, to some degree, the product of an intraparty struggle...
over the party’s brand that ended up conferring costs and benefits upon different subsets of partisans.

Ultimately, however, the ability of Congressional parties to unify their membership behind a clear, homogeneous label may be limited by the electoral advantage offered by individual maverickness. We have shown that establishing a distinct personal record provides an individual legislator with an alternative to a difficult and costly campaign. Consistently bucking the party on record provides an incumbent with a fairly inexpensive method of drawing attention to himself in lieu of spending campaign money (and having to raise it in the first place). Furthermore, the electoral payoff of a distinctive individual record increases as the party reputation becomes stronger.

Perhaps the party in power can forestall defections from the party brand by paying incumbents off with electorally useful resources that make up for the burden created by its collective reputation. For example, an incumbent’s district may receive targeted government expenditures that benefit the incumbent electorally (Carroll and Kim 2010). Party leaders heavily involved in fund-raising and the disbursement of campaign funds might target their money specifically at these marginal incumbents precisely because they need it most, and because these incumbents are particularly tempted to defect. However, because the electoral advantage of being a maverick rises as the party reputation becomes more informative, such side payments must rise as well. If so, too much cohesion—and too informative a party label—might simply
become something that a party cannot afford.
Figures and Tables
Figure 3.1 Diagram of the Model
Table 3.1 Effect of Party and Individual Reputations on Incumbent Campaign Expenditures: Two-Way Fixed Effects Regression, House Elections: 1972-2008\(^{18}\)

<table>
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<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
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<td>Uncertainty in Party Reputation</td>
<td>-2985.59* (1291.12)</td>
<td>-147.87 (590.18)</td>
<td>-641.30 (643.06)</td>
<td>-3882.84** (1252.88)</td>
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<td>District Partisanship</td>
<td>-11.05** (3.85)</td>
<td>-1.71* (.86)</td>
<td>-.55 (.545)</td>
<td>-11.78** (3.85)</td>
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<tr>
<td>District Partisanship ×</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Uncertainty in Party Reputation</td>
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<td>57.67** (20.13)</td>
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<td>Incumbent-Party Distance</td>
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<td>-518.94* (203.48)</td>
<td>-1303.59** (406.81)</td>
<td>-1893.60*** (447.37)</td>
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<td>Incumbent-Party Distance ×</td>
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<td>7232.64** (2316.57)</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>District Partisanship</td>
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<td></td>
<td>8.93** (3.36)</td>
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<td>.62*** (.054)</td>
<td>.62*** (.054)</td>
<td>.62*** (.054)</td>
</tr>
<tr>
<td>Challenger Quality</td>
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<td>56.10*** (10.33)</td>
<td>57.33*** (10.31)</td>
<td>57.67*** (10.34)</td>
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<td>Freshman</td>
<td>13.30 (9.93)</td>
<td>12.82 (9.92)</td>
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<td>13.13 (9.91)</td>
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<td>0.8565</td>
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<td>Adj. R(^2)</td>
<td>0.8267</td>
<td>0.8263</td>
<td>0.8267</td>
<td>0.8272</td>
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</table>

* p<0.05  ** p<0.01  *** p<0.001

\(^{18}\) Dependent variable = Incumbent’s campaign expenditures in thousands of 1983 dollars
Liang-Zeger (1986) standard errors, clustered on districts, are reported below each coefficient.

Figure 3.2 Marginal Effects of Uncertainty in Incumbent’s Party Reputation on Incumbent Campaign Spending as a Function of District Partisanship
Figure 3.3 Marginal Effects of Distance from the Party on Incumbent Campaign Spending as a Function of District Partisanship
Figure 3.4 Marginal Effects of Distance from the Party on Incumbent Campaign Spending as a Function of Uncertainty in the Incumbent’s Party Reputation
Appendix

In this appendix, we address how the uncertainty in personal reputations of the incumbents themselves shape their campaign spending, in addition to party reputation and the district characteristics, as noted in footnote 12.

The Effect of Variance in Personal Reputation

There are two consequences to a greater the uncertainty of an incumbent’s individual reputation. First, it makes it more difficult to show that the incumbent is in fact distinct from his party. Second, it inflates the perceived uncertainty of his position, in conjunction with that of the party. Both these effects lower the utility

19 The second effect simply echoes the argument by Shepsle (1972) that a candidate whose position is highly uncertain suffers a disadvantage when facing a risk averse electorate, and candidates may only choose ambiguous records because voters like it for some other reason. However, the first effect, which is central to our argument, is completely different from existing arguments about why voters might like or dislike candidates with ambiguous records. In our argument, a marginal incumbent faces an electorate that is hostile towards his party, and seeks to demonstrate that his own reputation has a mean different that of his party. The difficulty posed by a high degree of uncertainty in personal reputation is that it makes this demonstration and the consequent diversion of attention, away from party to the person, difficult. This argument is simultaneously analogous and different from the argument by Harden and Carsey (2010) and Jones (2003). In their argument, incumbents in heterogeneous
the voter obtains from choosing the incumbent. Specifically, Equation 7 implies a straightforward relationship between an incumbent’s campaign spending and the clarity of his personal reputation, $s^2$. This implies the following proposition:

Proposition A1:

An incumbent’s campaign expenditures increases as his personal reputation becomes less clear regardless of district or party characteristics.

Proof:

In all districts where the incumbent’s campaign spending is positive, i.e., $\bar{n} \geq 0$, the following must be true:

$$10) \frac{2\sigma^2}{s_i^2} (V - K) + \frac{\lambda \sigma^2}{2} > 0$$

This can be rewritten as:

$$11) \frac{2}{s_i^2} (V - K) + \frac{\lambda}{2} > 0$$

Differentiating Equation 5 with respect to $s^2$ yields the following.

districts might seek to avoid taking up clear positions because they fear offending a significant subset of voters. In our argument, incumbents in marginal districts would prefer to be disassociated with a party because they fear offending those who are not favorably disposed to their party. In our argument, however, not taking up clear positions makes it more, not less, likely that the incumbent would be associated with his party.
The left hand side of the Inequality 2 appears in the numerator, while the denominator is positive for all cases that we consider, as per footnote 11 above. Thus, the derivative \( \frac{\partial \pi}{\partial \sigma^2} \) must always be greater than 0 given Inequality 2, in all districts with nonzero incumbent campaign spending, regardless of district characteristics.

What are the potential measures that capture the uncertainty in an incumbent’s individual reputation? We have consistently used measures derived from the legislative records of both the party and the incumbents as stand-ins for their relative locations and uncertainties, specifically DW-Nominate Scores. DW-Nominate outputs provide a measure of uncertainty in form of bootstrapped standard errors of the legislators’ 1st dimensional DW-Nominate scores. However, alternate measures may be applicable, such as the number of roll call votes that a legislator participates in. The larger the value of an incumbent’s the bootstrapped standard errors are, the larger the uncertainty in his personal reputation is. The more votes that a legislator participates in, on the other hand, the smaller the uncertainty in his personal reputation is likely to be.

Table A-1 below provides the output of the full empirical model that includes each of these variables. Column 1 shows the results using bootstrapped standard
errors of 1st dimensional DW-Nominate Scores, Column 2 shows the results using the number of roll call votes, and Column 3 shows the results using both.

(Table A-1)

As expected, larger bootstrapped errors (which indicate greater uncertainty in an incumbent’s record) correspond to a modest increase in campaign spending. The number of votes cast in a congress also has the expected sign, but at a lower level of statistical significance. This provides some evidence that incumbents with a less ideologically consistent record find it more difficult to convey information about where they stand relative to the party and the voters in a district. However, these findings also suggest that these effects are comparatively insignificant relative to the party reputation and district characteristics, which we have described as more important.
Table 3.2 The Effects of an Incumbent’s Personal Reputation on Campaign Expenditures

<table>
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<tr>
<td>Uncertainty in Party Reputation</td>
<td>-3533.92**</td>
<td>-4072.15***</td>
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<td></td>
<td>(1052.54)</td>
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<td>District Partisanship</td>
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<tr>
<td></td>
<td>(2.93)</td>
<td>(3.022)</td>
<td>(2.9241)</td>
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<td>District Partisanship × Uncertainty in Party Reputation</td>
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<td>58.26***</td>
<td>50.71**</td>
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<tr>
<td></td>
<td>(15.56)</td>
<td>(16.09)</td>
<td>(15.58)</td>
</tr>
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<td>Bootstrapped SE of Incumbent DW Nominate Score</td>
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<td></td>
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References


