Learning from the Battlefield

Information, Domestic Politics, and Interstate War Duration

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Abstract

What drives leaders' decisions about whether to continue or end an ongoing war? The private information explanation for war holds that leaders fight because they believe that doing so will advance national interests, and settle when new information reduces their optimism about the possibility of long-term success. Yet significant theoretical disagreement exists about both the extent to which and the manner in which new information, especially battlefield information, promotes settlement. This article unpacks the logic of the informational mechanism, arguing that settlement will be more likely when there has been more extensive fighting and that countries are more likely to make concessions to end wars when battlefield results have deteriorated; short-term spikes in war intensity by contrast do not promote settlement. Moreover, building on work on leadership turnover and settlement, I show that leader replacement is sometimes part of the information updating process, especially in autocracies: new leaders without political ties to the person in power at the start of the war are more likely both to come to power when war is going poorly and to end wars once in office. Tests of these arguments make use of new participant-level data on the timing of battle deaths for all Correlates of War interstate wars, which allows me to examine the effects of changing battlefield developments across a wide range of cases in a manner that was previously impossible.

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The most enduring questions in international politics concern the origins of war and peace. Why do wars start, and once they have begun, when and why do they end? When do leaders make concessions to escape the fighting, and when do they stand firm? What happens when leaders, motivated perhaps by parochial interests, refuse to negotiate despite battlefield defeats?

The most prominent theoretical approach to answering these questions comes from the bargaining model of war, and within the bargaining model of war particular focus has been placed on the role of private information and divergent expectations about the consequences of fighting.[1] The difficulty of directly measuring information and beliefs have posed an obstacle to convincing tests of the informational mechanism, however, while in the absence of such tests theorists have developed a range of mutually incompatible predictions drawn from the same fundamental insights. In short, despite a general belief that information and beliefs play an important role in the onset and course of wars, much remains unsettled about the nature of the relationship.

This article advances the study of the informational mechanism in two ways. First, I unpack the logic of the informational explanation for war. Under the informational mechanism, war occurs when actors with serious political differences disagree about the likely consequences of war, and continues until revised expectations in response to wartime events bring the two sides' demands into alignment. I identify three distinct perspectives that agree that war is driven by private information but disagree about how combatants respond to new information and hence under what conditions war is likely to end. I ultimately argue for a perspective that predicts that settlement will be more likely when there has been extensive fighting to reveal information and following major shifts in battlefield success, but that *recent* spikes in war intensity will not have an independent effect on the probability of war termination. Moreover, building on work that demonstrates a connection between leadership turnover and decisions to end or continue an ongoing war, I argue that, especially in less democratic countries where leaders are less directly accountable to the public, replacing the existing leader may serve as part of the process by which lessons from the battlefield are translated into policy change.

Second, I introduce a novel dataset of monthly battle deaths that allows for a more convincing

[1] Fearon (1995) provides the classic statement of the bargaining model. For prominent studies examining the role and implications of private information, see Powell (1999), Gartzke (1999), and Reed (2003).

test of these predictions. Tests of predictions about the process by which actors transition from war to peace have been hampered by the absence of good information about what is happening within wars, in particular on the battlefield. This data allows me to capture shifts over time in the intensity of fighting, as well as variation in war participants' battlefield success. When combined with Croco's data on leadership transition within wars, I am able to conduct more convincing tests of established but unverified hypotheses, while also testing more novel predictions.[2]

Empirical analyses find robust support for the prediction that information revelation through battle sets the stage for war termination. I also show that leadership turnover is connected to settlement, and that turnover to nonculpable leaders, who are more willing to make the concessions necessary to bring war to a close, is particularly likely when war begins to go more poorly. That this relationship holds in particular for nondemocracies, in which institutional constraints on the executive create more room for policy diversion, suggests that there are established means by which states ensure that leaders do not continue wars that society would prefer to end.

1 Information, Domestic Politics, and War

The informational perspective on war has deep roots in the international relations literature. Building on prior neorealist theories about the sources of international conflict, Fearon identified a set of mechanisms that could produce war between two rational actors who suffer (and hence prefer to avoid) the costs of fighting.[3] While various scholars have proposed a range of different rationalist explanations for war, particular focus has been paid to the role of private information.[4] This logic has been used to examine questions about the origins, outcome, termination, and even recurrence

[2]Croco (2011).

[3]Fearon (1995).

[4]See for example Blainey (1988). Commitment problems, in which war occurs because actors cannot commit not to renege on agreements in the future, constitute the other unitary-actor mechanism that has received widespread attention. See for example Powell (2006) and Reiter (2009). Fearon also highlighted indivisible issues as a potential explanation for war, although he also raised important doubts about its relevance. As I discuss below, a number of studies have examined the possibility that principal-agent problems in domestic politics might lead to war, as in the case of diversionary war. In addition, Powell (1999) notes that war may be reasonable if there are significant costs (e.g. maintaining an expensive deterrent force) to peace; Slantchev (2003*a*) observes that war could occur if actors coordinate on an inefficient equilibrium; and Kirshner (2000) argues that war may be an attractive gamble for risk-acceptant leaders.

of war.[5]

Yet direct tests of the informational mechanism are notoriously difficult. The standard theoretical story—for example that Saddam Hussein invaded Kuwait because he believed that the United States lacked the resolve to reverse the conquest militarily—concerns beliefs about intentions, resolve, or capabilities, where both the initiator's beliefs and the target's resolve or intentions are almost impossible to measure systematically. As a result, the most convincing evidence for the informational mechanism comes from historical cases.[6] Statistical approaches have relied on indirect proxies, most commonly similar capability levels, that are plausible but open to multiple interpretations.[7] Indeed, because leaders should also recognize the logic of the informational mechanism, there is a strong theoretical reason to expect that it will be difficult to systemically identify situations in which private information is likely to lead to war.[8]

An alternate approach, which I follow here, is to examine war duration and termination. In the informational mechanism, war occurs because leaders on the two sides disagree about how the conflict is likely to go, each believing that its side is stronger, more resolved, more likely to receive outside assistance, or otherwise better prepared for the war. Once fighting begins, the two sides' conflicting expectations are put to the test, and given existing disagreements it is logically impossible for both to be borne out. Battles are particularly informative in this regard. If both sides expect to win a battle, then at least one must be surprised. If one leader believes that her opponent lacks the stomach for more than one round of fighting, the opponent's willingness to continue to fight even as casualties mount will be an indicator of greater than expected resolve. If one side expects a great power ally to bail it out if it gets in trouble, then those expectations will be put to the test once battlefield defeats force the great power to confront the choice between intervention or allowing its ally to be defeated. In general, therefore, fighting reveals information, which forces the two sides expectations' to converge; as expectations converge, so do political demands, until

[5]Examples for origins: Fearon (1994), Gartzke (1999), Powell (1999), Reed (2003). For outcome: Reiter & Stam (2002). For termination: Wagner (2000), Slantchev (2003*b*), Powell (2004), Reiter (2009), Weisiger (2013). For recurrence: Werner & Yuen (2005).

[6]Blainey (1988).

[7]For example Reed (2003), Slantchev (2004), and Bas & Schub (2015).

[8]Gartzke (1999).

at last a settlement emerges that both sides prefer to continued fighting.[9] If the two sides in a dispute both expect to benefit from fighting, at least relative to what their opponent is willing to concede at the bargaining table, then the actual occurrence of fighting is necessary for expectations to change. Moreover, more intense and extended fighting, which reveals more about the opponent's resolve while also providing a better indication of the likely outcome of additional battles, should be more informative, and hence should be more likely to produce settlement.

Important questions remain, however, about both the validity of this standard story and the plausibility of various ancillary predictions about how actors respond to new information in war. First, a number of studies have raised questions about whether the convergence process is likely to actually hold. Fearon shows that if parties cannot credibly commit not to revise war-ending settlements, the standard separating equilibrium in which weaker types accept less attractive offers may no longer hold; instead no serious negotiation occurs until the point at which the uninformed player is willing to make an offer that all types of the informed player will accept.[10] Separately, Langlois and Langlois demonstrate that when both sides in a war are uninformed, the convergence process may be transformed into a war of attrition, again implying that war aims likely will be stickier than the standard model would predict.[11] More recently, Fey argues that in some cases the existence of battlefield signals may actually decrease the probability of war settlement.[12]

A similar disjuncture concerns the implications of the informational mechanism for war duration, with some authors contending that wars arising out of private information will tend to be short, while others argue that informational conflicts can easily be quite extended.[13] At the same time, direct tests of the informational mechanism in war duration and termination are limited and inconclusive. Although Blainey provides anecdotal evidence in favor of the hypothesis, Reiter finds that, at least for the sample of highly destructive wars that he analyzes, leaders frequently did not adjust their war aims in response to negative developments.[14] In an analysis of fifteen twentieth-

[9] Blainey (1988, pg. 56) describes this process informally. Formal game-theoretic descriptions of the convergence process include Wagner (2000), Slantchev (2003*b*), and Powell (2004).

[10] Fearon (2013).

[11] Langlois & Langlois (2012).

[12] Fey (2014).

[13] For arguments that informational wars will be short, see Powell (2004) and Weisiger (2013). For the contrasting position, see Smith & Stam (2004) and Shirkey (2014).

[14] Blainey (1988), Reiter (2009).

century wars for which battle data was available, Ramsay found little evidence that informative battles hastened settlement.[15] Weisiger finds a contingent relationship between war intensity and the speed of settlement across a wider range of wars, but with a quite blunt measure of war intensity.[16] There is thus room for both greater clarity on the logic of the informational mechanism and better empirical tests.

Ultimately, I identify three different perspectives on the informational mechanism. In all three perspectives war occurs because private information leaves leaders unwilling to accede to opponents' demands, and it ends when new information forces leaders to revise expectations, and hence war aims, into sufficient accordance to permit the identification of a mutually agreeable settlement. The three perspectives differ, however, in the relative importance of specific events within the war, and hence make competing predictions about the conditions under which opponents are likely to reach an agreement to end the war. The three perspectives ultimately differ with respect to their predictions across the following three hypotheses:

Hypothesis 1 *Settlement will occur more quickly when the overall level of fighting in a war is relatively intense.*

Hypothesis 2 *Settlement will occur more quickly when recent fighting was unusually intense.*

Hypothesis 3 *Settlement will occur more quickly following substantial shifts in battlefield success.*

The *informational obsolescence* perspective complicates the standard picture by noting that just as wartime events reveal previously hidden private information, efforts of the war participants to achieve strategic, technological, or diplomatic breakthroughs can generate new private information that can easily extend war.[17] The strategic innovations that led to the emergence of the modern system in World War I, the technological breakthroughs by both German and American scientists during World War II, and the sustained Japanese effort to recruit Soviet mediation in 1945 all provide examples of cases in which new and relevant information left past lessons open to question

[15] Ramsay (2008).
[16] Weisiger (2013).
[17] On the emergence of new private information, see Goemans (2000, 34-36) and Shirkey (2014).

and hence provided the grounds for continued fighting even after years of intense combat.[18] If new information renders past lessons obsolete, however, then the observation that participants have had many opportunities to learn will not guarantee that they will be likely to be open to settlement. Instead, learning will be pitted against the development of new information, with war ending only when enough information has emerged to counteract both the initial divergence in expectations and whatever new information has complicated the question since war began. From this perspective, intense *recent* fighting should be particularly predictive of war termination, as participants receive extensive information about the current state of affairs, while more temporally distant battles will play at best a limited role.

An *outcome irrelevance* perspective focuses on the implications of surprising battlefield developments. Wittman argues that major victories for one side will not necessarily facilitate war termination, as the victor may raise war aims to a degree that offsets the loser's increased openness to concessions.[19] The increased confidence with which American leaders pushed for reunification of the Korean Peninsula after victory at Inchon, in contrast to the early aim of simply preserving South Korean independence, provides the best-known example for this argument.[20] From this perspective, major battlefield victories would determine the content of peace agreements but not their timing; which would depend instead on the total amount of information revealed through past fighting.

I argue in contrast for a third perspective, which takes issue with key elements of each previous argument. The informational obsolescence argument is correct that new private information is generated in war, but incorrect about this implications of this fact. For past learning to become irrelevant, new information would need to be both highly salient—having a significant impact on the outcome of the war should fighting continue—and, more critically, biased toward optimism. New high-salience private information is relatively rare—technological innovations along the lines of the tank or the atom bomb arise infrequently, and even major new developments are likely to be the basis for less variation in expectations than are prewar questions such as whether the

[18]For the modern system, see Biddle (2004).

[19]Wittman (1979).

[20]Reiter (2009, ch. 5) however argues that the shift in war aims largely predated success at Inchon, and hence cannot be attributed to that development.

opponent will be willing to fight at all. The bigger problem, however, is that for new information to render past lessons irrelevant and thereby encourage continued fighting, it would have to be consistently positive to an implausible degree. If new private information is bad, as with internal military dissension in several powers in World War I, then it will amplify the effects of past lessons, providing incentive to settle before the enemy learns of one's unexpected weakness. From this perspective, I expect the sum of past information to be a good predictor of war termination, but once this information is taken into account I do not expect recent spikes in violence to further increase the probability of settlement.

By contrast, I do expect that shifts in battlefield outcome will increase the probability of war termination, with losers more likely to make concessions to escape the war. Major shifts in battlefield success are particularly informative, because leaders' theories of victory frequently hinge on the expectation that a combination of factors will result in an eventual favorable shift in battlefield outcomes. As long as fighting is stalemated, both sides can retain expectations that future developments will shift the war in their favor, and hence will be less likely to make major concessions, even as they learn that the opponent is relatively resolved. A substantial worsening in battlefield outcomes strongly suggests that expectations of future improvements are unwarranted, however, and thus forces a more substantial revision in expectations for the loser. The outcome irrelevance perspective is, of course, correct that the winner can increase its demands to offset the loser's concessions, but such revisions should take place only when the victory is unexpected. Because the winner's initial war aims reflect the expectation of eventual success in fighting, success on the battlefield should be unsurprising. As a result, major shifts in battlefield success should induce the loser to make concessions that increase the probability of war termination on the winner's terms.

Table 1 summarizes the predictions of each perspective on the informational mechanism with respect to each of these three hypotheses.[21]

[Table 1 about here.]

[21]It is not entirely clear what prediction to draw from the information obsolescence perspective about hypothesis 3 or from the outcome irrelevance perspective for hypothesis 2. In both cases, I adopt the approach that is most ultimately most consistent with the evidence.

1.1 The Intersection of Information and Domestic Politics

As typically articulated, the informational mechanism rests on the assumption that policy is set by actors (leaders) who aim to advance the interests of the nation, taking into account the limited information about what optimal policy choices may be. Studies focused on domestic politics have argued, however, that leaders may fail to achieve this standard, whether because they redirect policy to serve personal ends or because they simply fail to recognize what the optimal policy might be.[22] Thus, for example, Goemans argues that leaders of partial democracies, such as Germany in World War I, risk both loss of power and personal punishment should they settle a war on losing terms, and hence that they will prefer a gamble for resurrection to admitting defeat.[23] More broadly, Stanley argues that leaders may resist settlement to protect parochial interests, but also because psychological or organizational biases may prevent them from recognizing that settlement on the opponent's terms is appropriate.[24] She thus predicts and finds that shifts in the ruling coalition, which bring in actors with both differing interests and differing perspectives, will increase the probability of war termination.[25] Croco similarly argues that if war goes poorly constituents punish leaders who either started a war or are allied to the initiating leader, but do not punish new leaders without clear ties to the initiator; as such, new nonculpable leaders can safely settle on terms the initiators would have rejected.[26] Both of these arguments predict that war termination is more likely when new leaders without ties to the war initiators take power.

Hypothesis 4 *Leadership turnover will be associated with quicker settlement and with greater willingness to make concessions to exit losing wars, especially when the new leader is not viewed as responsible for the decision to fight the war.*

This prediction, while plausible, remains to be systematically tested. Croco demonstrates that culpable leaders tend to achieve war outcomes that are better on average but that also exhibit higher variance, and that culpable leaders are likely to be punished for losing wars, while nonculpable

[22] See in particular Bueno de Mesquita, Smith, Siverson & Morrow (2003).
[23] Goemans (2000). On gambling for resurrection, see Downs & Rocke (1994).
[24] Stanley (2009).
[25] For a similar argument focusing on the specific case of Austrian domestic bargaining in the Seven Weeks War, see Stein (1997).
[26] Croco (2011).

leaders are not; her empirical analysis, however, does not explore war duration and termination. Stanley directly examines war duration, but a limited universe of cases—a consequence of focusing for data reasons on the post-1945 period—forces her to omit important covariates, while regressions that examine a broader list of interstate wars adopt the empirically questionable approach of coding leadership turnover only following the final change in leadership during a war. It is thus worth establishing that hypothesis 4 holds in a broader set of cases.

Moreover, empirical support for hypothesis 4 could arise from one of at least two separate theoretical logics. Under a principal-agent logic, leaders cynically divert policy to serve personal ends, for example responding to worsening battlefield conditions by gambling for resurrection rather that making concessions to end the war because they anticipate the losing power, freedom, or their life if they accept defeat. If society is unable to constrain these leaders, then war will continue until either the gamble for resurrection plays out or the leader loses office for unrelated reasons.

That said, hypothesis 4 also follows logically from the informational mechanism under reasonable assumptions about the logic of domestic politics. Work on leaders convincingly demonstrates that they differ in their interpretations of optimal policy under similar circumstances.[27] Moreover, Stanley argues that limits on leader rationality may result in failure to respond appropriately to new information.[28] In this context, leaders may deviate from socially optimal policy not because they are pursuing personal interests but because their understanding of optimal policy is misguided or because they are politically unable to make the concessions that are now seen to be necessary. As a result, the revision in government beliefs and hence policy may occur either through the leader's own changing beliefs or through constraints placed on the leader by the rest of society, in the extreme through the leader's removal. Indeed, even if the leader would prefer to gamble for resurrection, if she anticipates or experiences removal from office for not settling when war goes poorly, then policy will ultimately conform relatively closely to the logic of the informational mechanism. Along these lines, Weeks's discussion of foreign policy in autocracies implies that there is an inverse relation between incentives and ability to implement diversionary policies: leaders with large audiences anticipate punishment in response to failure but must consult extensively

[27]Saunders (2011), Horowitz & Stam (2014).
[28]Stanley (2009).

when implementing policy, while leaders with small or no audiences have the ability to divert policy but do not need to gamble for resurrection because they are unlikely to be punished for defeat.[29]

Examples of leaders being removed in response to apparent defeat are readily available. In the Second Schleswig-Holstein War, the Danish king responded to unexpected defeats and the failure of a final appeal to Britain by replacing the government in anticipation of an armistice.[30] Similarly, the reluctance of the existing regime in Germany to acknowledge defeat in World War I led the government to abdicate when defeat seemed inevitable, ceding power to a civilian government that agreed to an armistice. In sum, leadership turnover could produce settlement either because the new leader lacks the incentive to gamble for resurrection or because the new leader was selected based on the recognition on the basis of wartime events that it was time to pursue peace.

Distinguishing between these two perspectives is not straightforward. That said, a key distinction concerns the circumstances under which leaders are replaced, especially by successors who are more likely to settle. If principal-agent dynamics are primarily responsible for the elongation of wars prior to leadership turnover, then turnover to new leaders, especially leaders who are amenable to settlement, should be uncorrelated with battlefield dynamics, and especially should not be substantially more likely when the war is going poorly. By contrast, if leadership turnover is part of the process by which the informational mechanism unfolds, then we should expect downturns in battlefield success to predict transitions to leaders who are more open to settlement. Indeed, the logic of this argument can be taken one step further. Replacing leaders is only the most extreme means by which society can ensure that the leader does not pursue undesirable policies; in governments with thick institutions, options exist for reining in the leader short of removal, such as through legislative oversight of foreign policy.[31] If so, then replacement of the existing leader should be particularly likely when alternative options for reining in the leader are scarce, a situation that is more likely in non-democracies.

[29] Weeks (2014).

[30] Embree (2006, 341).

[31] See for example Howell & Pevehouse (2007) for the argument that Congress can exert a substantial check on presidential uses of force, especially in high-salience disputes.

2 Methods and Data

The hypotheses delineated above concern wartime decisions of whether to keep fighting or make peace and whether to replace an existing leader. Tests thus need to examine wartime developments, which I do using duration models. The unit of analysis is the day of fighting, specifically the war day for analyses of war termination, the war-side-day for analyses of the timing of concessions, and the country-war day for analyses of the timing of leadership turnover.[32]

2.1 Time-Varying Battle Death Data

Testing these arguments requires data that varies within wars. Although it is possible to use deaths in the war as a whole to generate a rough (and constant) estimate of war intensity for individual periods of the conflict, the resulting estimate is frequently incorrect, and the method of constructing the intensity variable (dividing war deaths by duration) introduces the dependent variable on the right hand side of the regression equation. Moreover, only time-varying data can be used to assess hypotheses that depend on within-war changes, whether in how intense the fighting is in general or how well the war is going from an individual participant's perspective. A central contribution of this paper is thus to introduce novel data based on participant-level estimates for monthly battle deaths that allows for a more appropriate test of important hypotheses about war duration and termination.

2.1.1 Why Battle Deaths?

Before discussing the data, it will be worthwhile first to discuss the decision to focus on battle deaths, rather than possible alternative measures of intra-war developments. Broadly, this question takes two forms. First, why estimate deaths in fighting, rather than examine events at other levels of analysis, most obviously battles? Second, why examine battle deaths specifically, as opposed to other measures of wartime losses such as total deaths (including deaths in accidents or disease) or

[32]Time-varying information is generated at level of the calendar month or year. I use the war day to avoid the creation of artificial ties in the data: rather than having every war that lasts less than a month be treated as having the same duration, this approach preserves the knowledge that the Six Day War was shorter than the Turco-Cypriot War, for example.

casualties (including the wounded and POWs). In both cases, I argue that an approach based on battle deaths, while imperfect, is preferable for both theoretical and empirical reasons.

One alternative is to focus on battles or campaigns as the unit of analysis.[33] Indeed, studies that examine time-varying wartime events typically have taken this approach, either by working from the CBD90 (HERO) dataset of battles assembled by the US Army or by coding events in a subset of battles in a war.[34] Advocates for this approach would argue that it is the results of battles, such as the successful German strike through the Ardennes in May 1940 or the failure of the final major German offensive in the Battle of the Bulge, that drive the decisions of wartime participants. Moreover, battles may constitute a significant victory for one side or the other without this development being reflected in the casualty figures. In the Russo-Polish War, for example, first the Bolsheviks in Ukraine and then the Poles outside Warsaw managed to fundamentally change the course of the war by striking aggressively through gaps in their opponents' lines, forcing the opponent to withdraw in haste and surrender large areas of conquered territory.

The problem with using battles as the unit of analysis is that there is no agreed standard by which to code an event as a battle.[35] It is impossible to record every instance of combat in a major war, yet there is also no obvious point at which to distinguish between a battle and a minor skirmish that can be safely ignored. At the opposite extreme, extended bouts of fighting like the siege of Sevastopol in the Crimean War or the Battle of Stalingrad in World War II could just as

[33]Given the salience of the opponent's bargaining behavior for models of politics within war—actors in formal models frequently learn more from the bargaining table than from the battlefield (e.g. Powell 2004)—an alternative approach would be to focus on developments at the negotiating table. In practice, however, the centrality of negotiation in the updating process of most models is a function of the limited information that can possibly be conveyed by war (typically, a round of fighting either gives one side total victory in the war, in which case no further bargaining is necessary, or has no effect beyond imposing costs on the participants), as well as the standard information structure in which only one side is uninformed about any aspect of the game, and that side makes the proposals. Moreover, bargaining demands are informative because of the costs of war, with battlefield deaths the central aspect of those costs. From an empirical perspective, the frequency of secret negotiations and of informal peace feelers that may or may not represent government policy makes it hard to clearly identify when negotiation is occurring. Shirkey's (2009) focus on unanticipated events (both military and diplomatic) constitutes a different possible approach, though given his focus on intervention in interstate wars his data examines whether events were surprising from the perspective of observers. Coding unexpected events from the perspective of participants is complicated because developments that are surprising for one side may be expected by the other.

[34]For examples of studies using the CDB90 dataset, see Reiter & Stam (2002) and Ramsay (2008). For examples of studies that examine a subset of battles, see Werner & Yuen (2005) and Horowitz & Grauer (2012).

[35]See Biddle & Long (2004) for a discussion of these limitations in the specific context of the CDB90 dataset, and Cochran & Long (2014) for an alternate approach to identifying battles that notes the low overlap between existing battle datasets.

easily be broken into a series of component battles. Moreover, the way historians divide wars into battles is almost certainly endogenous to features of the war that we would like to use the battles to explain. For example, had World War II ended in June 1940 following the fall of France (a possibility to which Hitler was quite open and that the British seriously discussed), it is likely that we would refer today not to a single battle of France but to series of battles from the Ardennes and Flanders to the French interior, as is the case with the various distinct battles preceding and following the Battle of Sedan in the Franco-Prussian War. Even more problematically, an approach that focuses on battles has no obvious way of dealing with guerrilla wars in which one participant specifically avoids major battles—it is telling, for example, that despite the overrepresentation of American battles in the CBD90 dataset Ramsay was forced to omit the Vietnam War from his analysis because he had information for only a single battle.[36] Nor can an approach focused on battles distinguish readily between cases like the Western Front of World War I or the Iran-Iraq War in which localized battles occurred in the context of constant fighting along a basically fixed front from cases like the 19th century War of the Pacific in which armies met for battles and then disengaged, with little to no fighting occurring until the next major encounter.

As for the arguments for using battles instead of battle deaths cited above, the occurrence of intense battles is unsurprisingly reflected in battle death counts. While it is true that it is possible to have a decisive battle in the absence of major losses if one side manages to outmaneuver or outflank its enemy, in practice such developments, as in the Russo-Polish War or with the German breakthrough in the invasion of France, put the victor in a position to impose heavy casualties (including significant battle deaths) on the side that suffered defeat; indeed, it is often the ability of the initial victor to exploit its advantage that determines whether the battle comes to be seen as decisive. All of these points imply that battle deaths have significant advantages over battles as a unit of analysis.

The second question is whether it would be preferable to use some other metric for losses, such as battle-related fatalities (the Correlates of War approach), casualties, or all deaths (including among civilians). For some questions, such as the determinants of the total human costs of war,

[36]Ramsay (2008, 875).

battle deaths are obviously less appropriate than alternatives; for the purpose of examining how military developments affect political decision making in war, however, it makes sense to focus on military forces. One could also argue that military and political leaders care primarily about the number of soldiers they are able to put in the field, and thus that the distinction between a soldier who dies in combat and others who die of disease, suffer incapacitating injuries, or are taken prisoner is immaterial. While data that account for all types of military losses would obviously be preferable, there are good reasons based on data availability for focusing on battle deaths. In many cases, battle deaths are the only figure available.[37] As for casualties or POW losses, even when data are available, different countries apply different standards, for example counting as a casualty any injury that requires treatment or only those that require extended hospitalization.[38]

2.1.2 Estimating Battle Deaths over Time

The coding process begins with the Correlates of War list of interstate wars.[39] Following convention in the literature, I disaggregate the World Wars into component conflicts, a Western and an Eastern War in World War I and a total of ten component wars in World War II (not counting the Second Sino-Japanese War, which is also distinct). Using this list, I identified a best reasonable estimate for total participant-level battle deaths and for the date of conflict onset and termination, consulting tertiary, secondary, and occasionally primary sources on the conflict.[40] The next step was to

[37] An unexpected consequence of COW's focus on battle-related fatalities is that coded American deaths in the Mexican-American and Spanish-American are substantially higher than those of their opponents, despite American forces consistently faring better in individual battles, because information about deaths from disease is only available for the US.

[38] This problem lay at the heart of a heated interwar debate in Britain about strategy in World War I, which turned in part on the comparability of British and German casualty figures. McRandle & Quirk (2006).

[39] For more detail on the data collection process, including coding rules and sample case narratives, see Weisiger (2015). The statistical appendix discusses robustness checks related to whether particular conflicts met the COW criteria to be considered a war. One could in principle adopt alternate approaches, including coding as a war any case in which both sides uses force (even if it does not meet the 1000 death threshold) or disaggregating conflicts into warring dyads. The approach used here maintains continuity with existing literature and most clearly retains the war as the unit of analysis.

[40] Commonly used tertiary sources include Clodfelter (2008) and Sarkees & Wayman (2010). For war onset and termination, I typically adopted codings that are quite similar to those in COW, with differences most frequently arising in cases in which COW codes a war as continuing until a peace treaty is signed, despite the presence of a prior armistice that brought an end to fighting. By contrast, my coding of total battle deaths frequently differs, sometimes substantially from that in COW. These differences are partly a consequence of different coding criteria—COW aims to capture all battle-related fatalities, which includes accidental and disease deaths, whereas I focus on the narrower category of battle deaths—but also reflects the opportunity to consult sources published since the original COW death data was collected.

gather available time-varying information on battle deaths during the war. In some cases, this information consisted of monthly death reports or of lists of the dates on which individual soldiers died, which could be easily converted into monthly battle death figures.[41] More commonly, the available information consists of data on deaths in particular battles or campaigns or over specified periods of the war. In these cases, where possible I first break the conflict into periods (e.g. every year of Austria-Hungary's involvement in World War I, given information about total yearly Austro-Hungarian losses), and then assign incident and campaign deaths to the periods in the year in which the relevant fighting was occurring. This process, with rare exceptions, accounts for only a subset of deaths in the period in question; any residual deaths were then allocated at a constant rate over the period of interest. In a small number of cases, such as the Estonian and Latvian Wars of Liberation after World War I, the historical record contained information about periods of higher- and lower-intensity fighting for various participants, but did not contain information about incident-level deaths. Rather than assume that the intensity of fighting was constant over time in these cases, I generate relative intensity scores for different periods based on the historical accounts, which can then be used to generate estimates of monthly deaths for each participant. Coding decisions are recorded in narratives (which in total run to more than 400 pages), supplemented in many cases by additional statistical calculations.

As this description should make clear, in the vast majority of cases the data constitute estimates of battle deaths in a period rather than the (unrecorded or unavailable) true values. For my purposes here, however, the critical question is whether the data reasonably reflects periods of greater or lesser war intensity. To cite an extreme example, in the opening year of the Russo-Polish War very little fighting occurred, as the Bolsheviks were primarily concerned with winning the Russian Civil War. Fighting intensified dramatically in the final months of the war, however, culminating in the dramatic, and intensely-fought, Battle of Warsaw. A naive approach that simply assumed that deaths per month were constant over the war would thus dramatically overestimate deaths for much of the war, only to dramatically underestimate them in the final stages. The estimates here,

[41] This process was more complicated in cases, as with information from the Commonwealth War Graves Commission, when dates of death were reported for all soldiers who died during the war, including those who died outside battle. In these cases it is necessary to draw on additional information, such as the place of burial, to eliminate likely nonbattle deaths prior to doing the final count.

although likely technically incorrect in every month of the war, undoubtedly are far closer to the unknowable truth.

Figure 1 provides examples of the resulting data for a representative sample of wars, including estimates of daily death rates (summed for all participants) as well as a dotted line at the average death rate for the war as a whole.[42] As is evident, there is substantial variation in war intensity over the course of conflicts. There are cases like the Russo-Polish War where intensity increased late in the war, as well as cases like Korea where initial high-intensity fighting gave way to lower-intensity combat in later years. The Iran-Iraq War experienced a fairly constant baseline level of fighting interrupted by periodic spikes in intensity associated with Iranian offensives. Even in a case like the Badme Border War between Ethiopia and Eritrea, where estimated war intensity is quite close to the average for much of the conflict, there can be a late increase in intensity that is significant for some theories of decision making in war. Figure 1 does illustrate some of the limitations of the data. For cases like the Badme Border War, where information about deaths in incidents is limited, estimated intensity levels vary less over time than deaths likely did in reality. In some cases, battle death estimates understate effective losses, as in the Eastern War in World War II, where high prisoner of war losses in the initial months and at Stalingrad are not counted—both periods, though still intense, do not stand out as much in these data as they do in the historical record. Even given these limitations, however, this data clearly better captures wartime developments than any existing alternatives.

[Figure 1 about here.]

I use this data to generate several specific variables for use in the analysis. The first is the total intensity in the war through the day in question, where intensity through day $t \in T$, T being the total number of days in the war, is the natural log of total battle deaths through day t, divided by the participants' total population.[43] Formally, for the set P of participants in the war, intensity I

[42] Daily death rates are estimated by dividing total deaths in the month by the number of days of fighting.

[43] The battle death data is collected at the monthly level, so estimated daily battle deaths are monthly deaths divided by the number of days in the month. The inclusion of population reflects the obvious point that a battle that kills 1000 soldiers is far more informative in a war between two small countries than it would be in a conflict between, say, Russia and China. The natural logarithm ensures that the variable is reasonably normally distributed, though results are consistent when using the unlogged variable.

through day t is calculated according the formula below:

$$I_t = \frac{\sum_P \sum_1^t dead}{\sum_P pop} \tag{1}$$

This variable is used to test hypothesis 1, which predicts that higher levels of past fighting will increase the probability of settlement.

A second variable is needed to evaluate hypothesis 2, which predicts that recent information is particularly salient by exploring whether the recent trend is towards higher-intensity fighting. This variable is constructed by comparing war intensity in the most recent sixty days of the war with war intensity for the war as a whole, according to the following formula: *Recent Intensity*= $\frac{\sum_{t-60}^t dead}{\sum_{t-60}^t dead + \sum_1^t dead}$. *Recent Intensity* varies between zero and one, with values greater than .5 indicating that recent fighting has been more intense than average for the war.

A third variable is needed to capture battlefield trends. Analysis using this variable focuses on behavior of one side in the war, and uses shifts in loss exchange ratios to capture changing battlefield success. I define the variable *Battlefield Trend* for actor i at time t to be i's share of all battle deaths in a set period prior to day t minus the same share for the war as a whole. The variable thus is bounded between positive and negative one, with positive values indicating that recent fighting has taken a turn for the worse from the country's perspective. The primary analysis uses the trend over the previous sixty days, though I also examine trends over 30, 90, and 120 days with similar results.

2.2 Leadership Turnover

For leadership turnover, I rely on Croco's data on leadership change in war.[44] Croco argues that leaders who are viewed as culpable for the decision to fight, either because they were in power when the war started or because they are of the same faction as the leader who started the war, will fear punishment and hence resist settlement when war is going poorly, while nonculpable leaders will not face the same concerns. She identifies a total of 355 leaders in interstate wars, of whom 96 were replaced before the war ended. Of these 96 new leaders, 45 were coded as culpable for the decision

[44]Croco (2011). I thank Sarah Croco for sharing the data with me.

to go to war, while the remainder were not.[45]

For the analysis of war duration and termination, I generate several different variables to capture the effects of leadership turnover. If leaders who started wars pose obstacles to ending them, then their replacement by new leaders, especially in more powerful states that presumably have more control over wartime decision-making, should facilitate peace. I thus use the Correlates of War's National Military Capabilities dataset to calculate the percent of total wartime capabilities (i.e. the sum of CINC scores across war participants) controlled by states that have experienced leadership turnover. In addition, the logic of the culpability argument holds that even nonculpable leaders who do not end wars are likely to assume culpability if they continue to fight them, implying that the effects of leadership turnover should weaken over time. For the primary analysis, I then generate variables that capture the percentage of wartime capabilities controlled by new leaders, with the effect of leadership turnover decreasing over time until the new leader is treated as fully culpable after one year has elapsed. To avoid overweighting the effects of turnover in very powerful states fighting asymmetric wars, I construct turnover scores separately for each side in the war and then sum them and divide by two. Formally, *% New Leader* is defined as follows, where t is the day of the war, P_s is the set of war participants on side $s \in \{1, 2\}$, R_s is the set of participants that have experienced leadership turnover since war onset and no more than 365 days previously, and d_{rt} is the number of days that have elapsed since country r experienced turnover:

$$\%NewLeader_t = \sum_S \frac{\sum_{R_s \in P_s} cap_r \frac{365 - d_{rt}}{365}}{2 \sum_P cap_p} \tag{2}$$

More fine-grained tests require distinguishing between new culpable and new nonculpable leaders. I thus also derive the analogous variables *% New Culpable* and *% New Nonculpable*, which capture the share of capabilities (again declining over time) controlled by either new culpable leaders or new

[45]Croco's data is based on version 3.0 of the Correlates of War interstate war dataset, and thus omits wars added in the most recent update, with the exception of the Badme Border War. She also omits a few conflicts from the earlier list of wars, presumably because of missing data. I filled in missing data myself, where possible using the Archigos dataset's list of leaders, while coding culpability myself. In earlier wars that are missing from her data, it is consistently clear that no leadership turnover occurred, with the exception of the 1849 Roman Republic conflict. The Roman Republic had an unusual triumvirate government structure, and membership in the triumvirate shifted over time. Most histories, however, treat Guiseppe Mazzini as the effective political leader of the Republic, so I adopt that approach. Alternate approaches to handling this case does not substantively influence my results.

nonculpable leaders. I conduct further robustness checks, reported in the statistical appendix, in which the effects of leadership turnover do not decline over time and in which I distinguish between turnover on the initiating and defending side in the conflict, in both cases finding quite comparable results.

For the analysis in which leadership turnover is the dependent variable, I simply use a dummy variable that takes a value of zero if no turnover occurred in the country in question and one otherwise. To avoid double counting, I combine observations for the small number of countries that are involved in multiple wars simultaneously, comparing their casualty rates to those of their opponents across all wars. This approach means, for example, that Japanese deaths in border wars against the Soviet Union in 1938 and 1939 are combined with deaths fighting China in the Sino-Japanese War. In cases in which countries switch sides or exit wars only to reenter later, I treat the new period of involvement as a separate observation, as the leader is now being judged for a different decision than the one that initially brought the country into the war. This process identifies a total of 427 leaders, of whom 103 are replaced during the war, 44 by a nonculpable substitute.[46]

2.3 Additional Control Variables

The remaining control variables for the main duration analysis are drawn from Weisiger (2013); I summarize them briefly here, and in greater detail in the online appendix. *Power Shift* is the degree to which relative capabilities among participants shift in the ten years prior to war; larger shifts are a proxy for leader expectations of larger future shifts and hence for commitment problems that should impede settlement. *Rough Terrain* impedes opponents' efforts to grapple with each other and hence should be associated with longer wars. I use terrain data from Slantchev.[47] Geographic *Contiguity* similarly should facilitate interaction and hence shorten wars, at least relative to wars fought by opponents who are quite distant from each other. Contiguity data comes from the

[46]These numbers differ from those in Croco's dataset because of the inclusion of observations for wars not in her data and because of the exclusion of a few of her observations of leadership turnover that occurred after the standard date of war termination, as with Japanese leadership change in the aftermath of the Boxer Rebellion (while Japanese troops were still engaged in pacification in China).

[47]Slantchev (2004).

Correlates of War project; the variable is a dummy that takes a value of one is the primary dyad in the war shared a land border. Several studies have found that wars initiated by democracies have a particular profile, with the democracy tending to win fairly quickly.[48] I thus control for the presence of a *Democratic Initiator*, where a democracy is a country with a Polity IV score of seven or above. *Relative Capabilities* are also often expected to have a significant effect on war duration; I thus control for the share of total capabilities in the war held by the stronger side, using capability data from the National Military Capabilities dataset in COW.[49] Given the argument that multilateral conflicts have multiple veto points that can impede settlement, thereby lengthening the war, I control for the *Number of States* involved in the war.[50] Given arguments that wars among the major powers are qualitatively different from other conflicts, I control for the presence of a great power on each side in a war (*Major Power War*), using Levy's coding of the major powers.[51] Bennett and Stam argue that *Military Strategy*, broken into three categories of attrition/conventional war, blitzkrieg/maneuver, and guerrilla war/punishment, strongly influences war duration.[52] I thus use their coding scheme, which ranks different combinations of the strategies into an ordinal scale in which higher values would be expected to be associated with slower war termination. Finally, I control for the presence of significant *Cultural Differences* between the two countries in the primary dyad in the war, using Henderson and Tucker's operationalization of Huntington's classification of countries into different civilizations.[53]

I also distinguish between settlement and conquest, as the logic of the informational mechanism speaks to the probability that opponents in a war will reach a negotiated agreement to end the war, rather than that one side simply overwhelms its opponent militarily. Thus, for example, Germany in 1945 did not decide to agree to a political settlement with its enemies (indeed, no settlement was on offer, given the policy of unconditional surrender); instead, Germany lost the ability to sustain conventional resistance. Wars are coded as ending in conquest from the perspective of the losing leader if that side's military surrenders in its entirety or disbands, or if the country is totally

[48] Reiter & Stam (2002), Slantchev (2004).
[49] Bennett & Stam III (1996).
[50] Cunningham (2006).
[51] Waltz (1979), Levy (1983).
[52] Bennett & Stam III (1996).
[53] Henderson & Tucker (2001), Huntington (1996).

occupied. For analysis of the timing of concessions, I code a side in a war as making concessions if it is the loser of a war that ends through settlement, using COW data on war outcome to identify losers.[54]

For the analysis of leadership turnover, I control for a variety of variables commonly used in studies of leadership. Leaders face a higher likelihood of replacement in democracies and when they have been in office for a relatively short period of time. In addition, Chiozza & Goemans find that leaders who enter office irregularly face markedly different experiences from leaders who enter regularly.[55] I follow Chiozza and Goemans and others in controlling for the country's total population (using data from the National Military Capabilities dataset), albeit without a strong prior expectation about its relationship with turnover. *Time in Office* (logged) and *Irregular Entry* both come from the Archigos dataset, supplemented by my codings for leaders who left office prior to 1870. Finally, I control for economic indicators, though given extensive missing data I also present results with these variables excluded. Both *GDP per capita* and *Growth* are based on historical GDP estimates generated by Maddison.[56] Table 2 contains descriptive statistics for the different variables used in the analysis.

[Table 2 about here.]

3 Statistical Results

I present the results in two stages, focusing first on war duration and then turning to leadership turnover. Table 3 presents results for the analysis of war duration and war termination, focusing on tests of the informational hypotheses. Model 1 uses a Cox specification, examining duration until war termination.[57] Models 2 through 5 by contrast use a competing risks specification, with political settlement (models 2-4) and military conquest (model 5) the two possible forms of war termination. In all regressions, the reported results are variable coefficients (rather than hazard

[54]Results are robust to coding all losers as making concessions, coding draws as concessions, or using alternate data on war outcome.

[55]Chiozza & Goemans (2011).

[56]Maddison (2003).

[57]Tests of the proportional hazard assumption, both here and in tables 4 and 5, reveal no evidence of violations.

ratios). Positive coefficients imply that the variable is associated with an increased probability of war termination in any given day, and hence with a *decreased* expected war duration.

Throughout the analysis, I conduct a range of robustness checks to ascertain whether findings are driven by potentially arbitrary decisions about statistical specification. One set of robustness checks involves changes to the universe of cases: I add and remove cases in which there are grounds for uncertainty about whether the standard 1000 death threshold for coding as a war was met; I drop several wars in which official heads of state on one side sincerely opposed their country's involvement in the war; I aggregate the World Wars into single observations; and I drop some conflicts that arguably were internationalized civil wars. Second, I use alternate reasonable statistical specifications, replacing Cox models with a Weibull model and competing risks models with a Cox specification in which observations that fail due to competing risks are censored at the time of exit. Third, for analyses of war duration and the timing of concessions, I lose seventeen wars because of missing data for the prewar power shift variable. I thus conduct robustness checks with that variable omitted to ensure that the loss of observations is not biasing the results. Fourth, given reasonable concerns about data quality, I conduct additional robustness checks in which I drop observations for which I have relatively low-quality data, operationalized in one of five ways: if estimates for total battle deaths are poor (because of wide variation in reasonable estimates in the literature, or because estimates for total deaths do not exist), if they are either poor or questionable (because significant variation in reasonable estimates exists, albeit with the low estimate no less than 75% of the high estimate, because the standard estimate in the literature is described as open to question, or because the final estimate required omitting non-battle deaths), if no information exists on the timing of deaths, if no quantitative information exists on the timing of deaths, or if information on the timing of deaths covers less than 25% of total deaths. Results from the robustness checks are reported in the statistical appendix; unless otherwise noted in the discussion below, results are robust to these changes.

The results in table 3 shed light on the merits of the three informational hypotheses. First, consistent with hypothesis 1, the more fighting that has occurred in the past, the more likely war is to end in the immediate future. The observation in model 1 that more intense fighting is

associated with quicker war termination potentially could reflect the increased likelihood that one side conquers the other, rather than that the revelation of information leads to settlement. The competing risks analyses in models 2 through 4, however, reveal that increased war intensity is also associated with quicker settlement, though consistent with the alternative explanation higher war intensity is also associated with quicker conquest. In sum, the evidence is quite consistent with hypothesis 1. This result contrasts with findings in prior studies, where was intensity was only weakly related to war termination.[58] I argue that this difference is a consequence of improved data on both total deaths and the timing of deaths for a wide range of wars.

Hypothesis 2 predicts that wars will be more likely to end when *recent* fighting has been particularly intense. Model 3 tests this prediction by adding a variable that captures the extent to which recent war intensity is more or less intense than typical fighting for the war. Higher recent war intensity is associated with quicker settlement, but at a clearly statistically insignificant level. Closer examination reveals that, of wars that last more than two months, almost as many wars reached settlement following a lull (45%) as did following an increase in fighting (55%). This result also holds for war termination in general (including through conquest), and when using shorter or longer windows of time to capture recent trends. Contrary to the expectations of the information obsolescence perspective, therefore, there is little evidence to suggest that spikes in fighting increase the probability of war termination beyond the general effect accounted for by hypothesis 1.

The final informational hypothesis is that changes in battlefield outcomes will be associated with quicker settlement, with countries experiencing worsening conditions more likely to make war-ending concessions. To test this prediction, I shift the unit of analysis to the war-side, to examine the conditions under which one side in a war makes concessions. Model 4 reports the results from this analysis. When a country has suffered higher losses in recent fighting, it is substantially more likely to make the concessions necessary to bring an end to the war. A shift from the 50th percentile to the 90th percentile in the battlefield trend is associated with more than a 40% increase in the instantaneous probability of war termination. This result suggests that dramatic changes in battlefield outcomes are particularly informative, and hence is inconsistent with the outcome

[58] Wittman (1979), Ramsay (2008), Weisiger (2013).

irrelevance perspective on the informational mechanism.

In sum, therefore, the results are consistent with the third perspective on the informational mechanism. Higher overall war intensity robustly predicts settlement, as do significant battlefield reversals. By contrast, recent spikes in the intensity of fighting have no clear relationship with the timing of war termination.

Table 3 also contains initial results on the connection between leadership turnover and war termination. Consistent with theoretical predictions, war termination is substantially more likely following leadership turnover. In some cases, such as the replacement of Hitler following his suicide or the shuffling of South Vietnamese leaders in the final days of the Vietnam War, countries replace leaders just prior to military collapse. That said, leadership turnover is also clearly associated with quicker settlement, as shown in models 2-4.[59]

These results, however, do not distinguish between types of leadership turnover. Given the argument that new leaders behave differently depending on whether they had political ties to their predecessors, it makes sense to distinguish between leaders who retain culpability (because of ties to the leader who started the war) and leaders who are unlikely to be viewed as culpable. Table 4 presents these results. Although both types of leadership turnover are associated with quicker war termination, the effect is only statistically significant and is substantively stronger for transition to nonculpable replacement. The emergence of these leaders is associated with war termination through settlement (model 2), and countries that they govern are more likely to make concessions to end wars (model 4). By contrast, and consistent with the examples of Germany and South Vietnam, the emergence of new culpable leaders tends to precede war termination through the conquest of one side by the other. This effect is substantively significant: a shift from 0 for 0.5, which would correspond to a new nonculpable leader taking power in a country that is fighting without allies, produces more than a sixfold increase in the predicted probability of settlement. The primary analysis here relies on a measure of leadership turnover that declines over time, based on the argument that leaders gradually come to be seen as culpable if they do not end wars quickly, but model 3 demonstrates that the results are robust to substituting a nondeclining measure.

[59]This result is marginally statistically insignificant in a minority of robustness checks, as reported in the statistical appendix.

The results for control variables in tables 3 and 4 are largely consistent with prior findings, and will be discussed briefly. Larger prewar power shifts are associated with increased war duration, and in particular increased duration until settlement, consistent with a commitment problem story. Wars initiated by democracies also tend to be shorter on average, though less robustly, while rough terrain is associated with a substantial increase in predicted war duration. When relative capabilities are imbalanced, wars tend to be shorter, though this effect arises primarily because these wars reach conquest more quickly rather than because imbalance promotes quicker settlement. Similarly, military strategy influences war duration primarily through its effect on the speed of conquest. Other control variables either were consistently insignificant or, in the case of cultural difference, had an unanticipated relationship with the duration until conquest but did not pose an obstacle to settlement.

The discussion thus far establishes that new nonculpable leaders are more likely to settle, but it leaves open questions about whether this effect primarily reflects informational or principal-agent dynamics. A first useful observation is that most wars and ended up the same leaders who began them: leader turnover of any kind occurs in less than a quarter of wars that end through settlement, and nonculpable leaders emerge in only 14% of such conflicts. That culpable leaders frequently settle on losing terms implies that in many cases they either need not fear significant punishment for defeat, as for example Weeks argues is the case for personalist dictators, or that they are sufficiently constrained by other forces in society that they cannot get away with gambling for resurrection.[60]

Stronger evidence for the informational interpretation of the link between turnover and war termination would arise if turnover frequently is nonrandom. If nonculpable leaders come to power when the war is going poorly, then that would be evidence that leadership turnover is part of the broader information-updating process. This point would be particularly strong if such turnover is more likely in countries in which other institutional constraints on the leader are relatively weak.

Table 5 examines these possibilities by focusing on the link between battlefield events and leadership turnover. In models 1 and 2, the dependent variable is any kind of leadership turnover,

[60] Weeks (2014).

while models 3-5 focus on turnover to a nonculpable replacement and model 6 focuses on turnover to a culpable replacement. As elsewhere, the aggregated results in models 1 and 2 come from a Cox specification, while distinguishing among types of termination involves shifting to a competing risks framework. Models 1, 3, 5, and 6 omit controls for economic performance, while models 2 and 4 include them, thereby controlling for an important determinant of leadership tenure, albeit at the cost of losing roughly a third of all observations to missing data. Except as noted below, results for key variables with and without economic controls are quite comparable.

[Table 5 about here.]

The results are consistent with the predictions of the informational perspective. Worsening battlefield results are a marginally significant predictor of leadership turnover in model 1, though the variable loses statistical significance in model 2. The remaining models, however, reveal that the story is quite different for transition to new nonculpable as opposed to new culpable replacements. Transition to nonculpable replacements is far more likely in the aftermath of worsening battlefield conditions; this result holds whether or not we control for economic variables, and, as the statistical appendix demonstrates, through a wide range of statistical robustness checks. By contrast, when battlefield conditions worsen, countries are if anything less likely to replace their current leader with a political ally who will also be seen as culpable. Based on the results in model 3 and holding control variables at medians, a shift from a static war situation (the 50th percentile) to a value at the 90th percentile is associated with a threefold increase in the probability that a leader is replaced by a nonculpable alternative. There is thus strong evidence that countries make decisions about replacing leaders with battlefield events in mind.

Model 5 adds an interaction between democracy and battlefield trends to test the prediction that leadership replacement will be more likely in countries where constraints on the executive are weak. Consistent with this prediction, the interaction term is negative and statistically significant; overall, democracies are if anything *less* likely to bring in a nonculpable replacement leader following battlefield defeat. By contrast, the large and significant positive coefficient for *Battlefield Trend* demonstrates that non-democracies remain quite likely to shift to a nonculpable leader following substantial defeats. An analogous result holds when including economic controls. In short,

worsening battlefield conditions are likely to promote transition to leaders who are more willing to settle, but only in nondemocracies where leaders would otherwise be relatively free to divert policy to serve their own ends.

Results for control variables are fairly weak. Leaders with longer tenure are less likely to be removed in general, though this relationship is less clear when examining types of turnover. Stronger states on average replace their leaders more often, though more populous states do so less often. Democracies experience more frequent turnover to culpable replacement leaders, but do not experience similar turnover to nonculpable replacement. A leader's past war experience also occasionally has the expected relationship with the probability of turnover, but is typically insignificant. Other controls are typically in the predicted direction but statistically insignificant, likely reflecting differences between wartime and peacetime circumstances and the limited statistical power associated with the reduced sample of leaders who have been at war.

4 Conclusion

What drives decisions to fight, as well as decisions to end ongoing wars? Within the bargaining model of war, the informational perspective argues that wars occur when the two sides disagree about the likely consequences of fighting, and end when events within the war bring expectations about the consequences of further fighting sufficiently close to agreement to permit settlement. Although this broad story has been well understood, important theoretical debates persisted, and evidence that this process occurs has been less than fully compelling.

This article addresses these problems in the context of interstate war duration and termination, advancing our understanding of the informational mechanism in several respects. I delve into the theoretical argument, identifying several distinct arguments about the process of information updating that have important implications for the way in which wars driven by the informational mechanism unfold. An information obsolescence perspective holds that because new private information is generated over the course of a war, the lessons learned from earlier experiences will become irrelevant over time, and war termination will be more likely only when recent events have been particularly informative. I argue, however, that this perspective overstates the likely salience

of new information and rests on an implausible assumption that the new information that leaders receive will be biased in a positive direction. An outcome irrelevance perspective holds that because the winners of battles can increase their war aims to offset the concessions that losers are willing to make, the timing of war termination will be driven by the extent of information revealed, but dramatic battlefield shifts will not increase the probability of peace. I argue that this perspective fails to account for the two sides' preexisting theories of victory. In most cases, the side that achieves a significant victory based its war aims on the expectation that such a victory would eventually emerge, and hence will be unlikely to increase its demands to a degree that offsets its opponents' increased openness to concessions. These arguments then imply that settlement in war will be more likely when more information has been revealed, for example because a greater total amount of fighting has occurred, and when dramatic shifts in battlefield outcomes have occurred, but that taking these effects into account spikes in battlefield intensity will not significantly increase the probability of peace.

The article also examines the domestic politics of the informational mechanism. Traditionally, the informational mechanism has ignored domestic politics, but building on work on leadership turnover in war, I argue that the replacement of leaders is at times part of the process by which the process of updating of beliefs on the two sides plays out. Leaders may resist settlement either for parochial reasons, as in diversionary war, or because psychological, ideological, or organizational biases make them discount negative information more than they should. In either case, the rest of society may respond to this behavior by reining the leader in, in the extreme through her removal from office. If this process is occurring, then we would expect new leaders, especially leaders who are more amenable to settling, to be more likely to take office in the aftermath of battlefield defeats. Moreover, we would expect this sort of leadership turnover to be more common when formal institutions constraining the leader's behavior are weaker, as in autocracies.

Tests of these arguments rely on new participant-level monthly estimates of battle deaths for the Correlates of War list of interstate wars. This data provides coverage for a wider range of wars than are examined in existing quantitative studies of wartime developments, and it avoids many of the problems that are inherent to datasets organized around battles. I combine this

data with existing data on leadership turnover to examine the determinants of war termination. Better data permits me both to conduct a better test of the established prediction that information revelation through fighting will encourage peace and to examine more nuanced predictions about how changing battlefield circumstances connect both to peace and to leadership turnover. Results from these analyses are quite consistent with the posited hypotheses.

In sum, then, this article provides more compelling evidence of the informational mechanism than was previously available, while also providing more detail about how the updating of beliefs takes place. The finding that leaders are often replaced in response to battlefield defeats also stands in contrast to principal-agent perspectives, in which decisions about whether to continue or end wars are driven by leaders' calculations about their personal interests. The evidence presented here cannot rule out principal-agent dynamics in war, but it provides a cautionary note that merely observing connections between leadership turnover and the termination and outcome of war does not guarantee that leaders are able to divert policy toward personal interests over extended periods of time. More generally, this article reinforces the tragic view of war: the evidence here is that violence occurs not because of the machinations of self-interested politicians, but because leaders who are sincerely pursuing what they understand to be the general interest in the face of uncertainty fail to resolve their disagreements peacefully.

Table 1: Predictions from the Different Perspectives on the Informational Mechanism

Perspective	H1: All Info	H2: Recent Info	H3: Outcome Shifts
Informational Obsolescence	No	Yes	Yes
Battlefield Outcome Irrelevance	Yes	No	No
Sum of Relevant Information	Yes	No	Yes

Table 2: Descriptive Statistics

Variable	Mean	σ	Minimum	Maximum	N
War Duration					
log(War Intensity)	-1.07	2.39	-11.7	3.5	41505
Recent Intensity	0.49	0.15	$2.9\text{x}10^{-7}$	0.88	41505
Battlefield Trend	0	0.091	-0.64	0.64	83010
% New Leader	0.056	0.14	0	0.86	41505
% Nonculpable	0.021	0.083	0	0.5	41505
% New Culpable	0.035	0.11	0	0.82	41505
Power Shift	0.33	0.21	0.0068	0.88	36755
Democratic Initiator	Democracies initiated 20 of 97 wars (16.0% of war days)				
Rough Terrain	0.73	0.20	0.2	1.05	41505
Contiguity	58 of 96 wars (48.0% of war days) involved contiguous opponents				
Relative Capabilities	0.74	0.15	0.50	0.99	41505
Number of States	4.28	3.36	2	18	41505
Major Power War	13 of 97 wars (25.7% of war days) had major powers on both sides				
Cultural Clash	60 of 97 wars (64.0% of war days) involved cultural clashes				
Military Strategy	4.72	1.50	2	8	41505
Conquest	28 of 97 wars ended in conquest				
Leadership Turnover					
Battlefield Trend	-0.00014	0.090	-0.61	0.65	150108
Share of Deaths	0.24	0.28	0	1	150108
Democracy	125 of 416 leaders and 25.6% of war days involve democracies				
Population (billions)	0.054	0.11	0.000264	1.09	150108
log(GDP per capita)	0.79	0.95	-1.76	3.36	132074
Growth	0.020	0.076	-0.42	0.37	131828
log(Days in Office)	7.03	1.46	0	10.12	149985
Irregular Entry	77 of 416 leaders (22.3% of observations) entered irregularly				

Table 3: Battlefield Deaths and War Termination

	(1) Time to Termination	(2) Time to Settlement	(3) Time to Settle (Δ Intensity)	(4) Time to Concessions	(5) Time to Conquest
War Intensity	0.24**	0.45**	0.45**	0.59**	0.60*
	(0.092)	(0.11)	(0.11)	(0.099)	(0.27)
Recent Intensity			1.47		
			(1.68)		
Battlefield Trend				4.97**	
				(1.80)	
% New Leader	2.20**	2.34*	2.25*	1.70**	1.89†
	(0.78)	(0.97)	(0.97)	(0.59)	(1.06)
Power Shift	-1.08*	-2.66**	-2.74**	-2.87**	3.20**
	(0.51)	(0.66)	(0.66)	(0.71)	(1.02)
Dem. Initiator	0.93**	0.81†	0.78†	0.53	0.95
	(0.33)	(0.42)	(0.42)	(0.44)	(0.71)
Rough Terrain	-1.97**	-1.29†	-1.29†	-0.39	0.62
	(0.54)	(0.74)	(0.73)	(0.74)	(0.92)
Contiguity	0.12	0.30	0.28	-0.23	-1.16
	(0.26)	(0.37)	(0.36)	(0.38)	(0.77)
Relative Cap.	2.16*	-0.41	-0.62	-1.14	3.79†
	(0.93)	(1.22)	(1.27)	(1.24)	(2.00)
Number of States	0.0090	0.0068	0.00067	0.029	0.038
	(0.080)	(0.17)	(0.17)	(0.16)	(0.093)
Major Power War	-0.88†	-1.52	-1.59†	-1.02	-0.36
	(0.53)	(0.95)	(0.95)	(0.79)	(0.67)
Milit. Strategy	-0.67**	-0.031	-0.034	0.014	-0.57**
	(0.19)	(0.21)	(0.21)	(0.14)	(0.20)
Cultural Clash	-0.15	0.63	0.67	0.75*	-1.04*
	(0.26)	(0.43)	(0.44)	(0.36)	(0.47)
N	36755	36755	36755	73510	36755
Wars	81	81	81	162	81
Failures	81	55	55	48	26

Standard errors clustered by country. † $p < 0.1$, * $p < 0.05$, ** $p < 0.01$

Table 4: Leadership Turnover and War Termination

	(1) Time to War Termination	(2) Time to Settlement	(3) Time to Settle (Nondecaying Turnover)	(4) Time to Concessions	(5) Time to Conquest
% New Non-Culp.	3.25**	3.77**	2.58*	1.63*	0.63
	(0.96)	(1.09)	(1.00)	(0.66)	(1.72)
% New Culpable	1.11	-0.28	0.86	1.96*	3.44**
	(0.98)	(1.71)	(0.99)	(0.97)	(0.99)
War Intensity	0.22*	0.43**	0.43**	0.59**	0.60*
	(0.089)	(0.11)	(0.11)	(0.099)	(0.26)
Battlefield Trend				5.00**	
				(1.74)	
Power Shift	-1.03*	-2.59**	-2.66**	-2.91**	3.09**
	(0.50)	(0.63)	(0.64)	(0.73)	(1.04)
Dem. Initiator	0.96**	0.87†	0.81†	0.53	0.82
	(0.33)	(0.44)	(0.43)	(0.44)	(0.73)
Rough Terrain	-1.92**	-1.20	-1.31†	-0.39	0.54
	(0.54)	(0.76)	(0.73)	(0.73)	(0.90)
Contiguity	0.19	0.39	0.45	-0.23	-1.16
	(0.25)	(0.40)	(0.40)	(0.38)	(0.75)
Relative Cap.	2.41*	-0.12	0.089	-1.18	3.28
	(0.97)	(1.23)	(1.28)	(1.25)	(2.13)
Number of States	-0.0026	-0.018	-0.016	0.033	0.060
	(0.086)	(0.19)	(0.18)	(0.16)	(0.089)
Major Power War	-0.71	-1.29	-1.28	-1.06	-0.73
	(0.56)	(1.04)	(0.97)	(0.80)	(0.75)
Milit. Strategy	-0.70**	-0.037	-0.047	0.012	-0.52**
	(0.19)	(0.21)	(0.21)	(0.14)	(0.19)
Cultural Clash	-0.14	0.65	0.67	0.76*	-1.00*
	(0.26)	(0.44)	(0.45)	(0.36)	(0.48)
N	36755	36755	36755	73510	36755
Wars	81	81	81	162	81
Failures	81	55	55	48	26

Standard errors clustered by country. † $p < 0.1$, * $p < 0.05$, ** $p < 0.01$

Table 5: Determinants of Leadership Turnover

	(1) All Turnover (No GDP)	(2) All Turnover (GDP)	(3) Shift to Nonculpable (No GDP)	(4) Shift to Nonculpable (GDP)	(5) Shift to Nonculpable (Interaction)	(6) Shift to Culpable (No GDP)
War Worsening	1.97†	1.04	5.85**	3.87*	6.46**	-3.68
	(1.04)	(0.96)	(1.23)	(1.63)	(1.58)	(2.30)
Democracy×Trend					-10.9*	
					(4.64)	
Democracy	0.47	0.23	-0.12	-0.17	0.095	0.059
	(0.40)	(0.48)	(0.52)	(0.60)	(0.50)	(0.31)
Share of Deaths	0.32	0.30	-0.36	-1.07		-1.84**
	(0.46)	(0.60)	(0.76)	(0.98)		(0.62)
Time in Office	-0.26**	-0.33**	0.015	-0.066	0.032	-0.0088
	(0.095)	(0.11)	(0.078)	(0.080)	(0.081)	(0.059)
Irregular Entry	-0.28	-0.49	0.23	-1.15†	0.20	-0.095
	(0.32)	(0.41)	(0.51)	(0.66)	(0.53)	(0.28)
Won Past War	-0.11	-0.12	-0.066	-0.25	-0.10	-0.83†
	(0.27)	(0.28)	(0.41)	(0.43)	(0.41)	(0.46)
Lost Past War	0.63†	0.75*	-0.16	-0.11	-0.14	0.67†
	(0.36)	(0.33)	(0.66)	(0.74)	(0.68)	(0.36)
Capabilities	3.02*	2.89*	1.43	1.48	1.64	2.79†
	(1.28)	(1.38)	(2.68)	(2.63)	(2.37)	(1.50)
Population	-5.50*	-5.53*	-3.48	-1.91	-3.85†	-3.48*
	(2.49)	(2.78)	(2.54)	(2.05)	(2.26)	(1.40)
Econ. Growth		0.49		1.58		
		(1.45)		(1.85)		
Per Capita GDP		0.16		-0.13		
		(0.14)		(0.19)		
N	149985	131828	149985	131828	149985	149985
Leaders	415	355	415	355	415	415
Failures	103	88	44	33	44	103

Standard errors clustered by country. † $p < 0.1$, * $p < 0.05$, ** $p < 0.01$

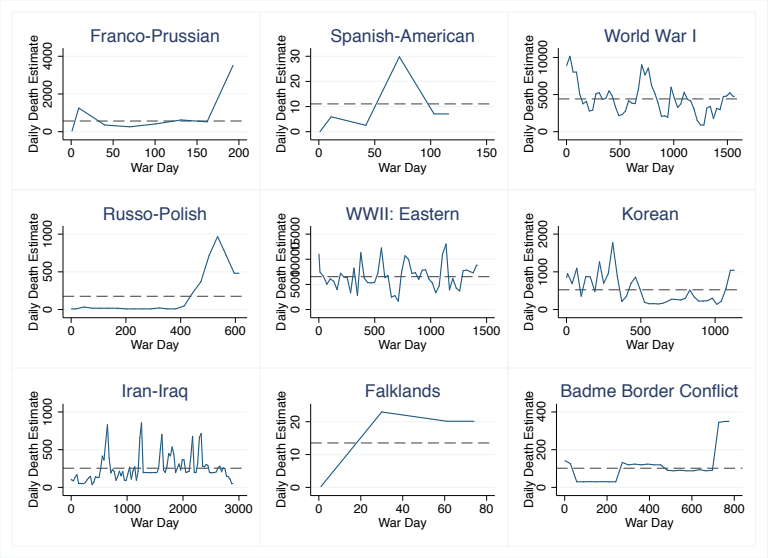

Figure 1: Monthly Battle Death Estimates from a Sample of Interstate Wars

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