

“Hot Hand”: A Critical Analysis of Enduring Rivalries

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Statisticians refer to discernible patterns of events that are nevertheless unrelated as a “hot hand.” An observer watching a gambler on a winning streak may suspect that the game is fixed, but it is not necessary to depart from standard probability theory to account for series of low-probability events. Enduring rivalries research often uses frequency counts of militarized disputes to identify rivalries as “enduring.” Nevertheless, discernible patterns in dispute data could be hot hands. Using the same datasets and definitions as the original researchers, we test the hypothesis that the number of enduring rivalries reported in the literature is significantly different from the number generated by a model in which disputes are randomly distributed. We compare the null model to existing definitions of enduring rivalry using a Poisson process. We find that we cannot reject the hypothesis that dispute series identified as enduring rivalries result from a stochastic process.

A chief advantage of and rationale for studying enduring rivalries centers on context. Enduring rivalries potentially constitute a series of disputes that belong together as a unit, either because these disputes share common origins or because initial disputes themselves contribute to subsequent conflicts. “Enduring rivalries have theoretical importance in challenging many assumptions of prominent approaches to international conflict; *that conflicts are related over time and space* questions traditional rational-choice and neo-realist approaches” (Goertz and Diehl 1995a, 32; emphasis added). We share the conviction of enduring rivalries researchers that evidence of a relationship between disputes separated longitudinally challenges conventional models of international relations. We are concerned, however, that in enduring rivalries research such a relationship is assumed rather than demonstrated.

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Definitions vary widely, but operationalizations generally use frequency counts of dyadic disputes to identify cases of enduring rivalry. Rivalries are deemed “enduring” if a sufficient number of militarized disputes occur within a certain period of time.¹ The centrality of case selection to enduring rivalries research necessitates the assertion that dispute series between rival states are related.² Goertz and Diehl (1993), in their evaluation of several of the most prominent studies of enduring rivalries, allude to the need for temporal association: “It is clear that some dyads become involved repeatedly in conflict. These multiple conflicts between the same states may indeed be unrelated, but this must be demonstrated, not assumed as is frequently the case” (148). We believe the opposite must be demonstrated, that the burden of proof of an argument lies with its proponents. In selecting cases, research using enduring rivalries assumes a relationship between disputes that is both empirically testable and untested. Using the same data and definitions developed by enduring rivalries researchers, we test the hypothesis that dispute frequency within certain dyads exceeds what probability theory would lead us to expect from a system in which disputes *are unrelated*. We ask whether a model of the international system designed so that disputes are statistically independent can generate enduring rivalries in numbers similar to those identified in the enduring rivalries literature.

As a prelude to the test, we assess the theoretical logic of research using enduring rivalries. Countering the assertion that enduring rivalries research challenges conventional models of international behavior, we argue that explanations of international relations available to us through enduring rivalries research are in fact subordinate to other explanations already available within other theoretical frameworks. Research performed to date generally fails to address directly the origin of initial disputes in dispute series identified as enduring rivalries. Motivation for initial disputes is thus left to be explained by other models of international conflict. Given that initial disputes are “caused” by factors exogenous to enduring rivalries, it is unclear why those same factors are unsuitable to explain subsequent disputes unless disputes in enduring rivalries are themselves a causal component of subsequent disputes. The logic of enduring rivalries may supplement other explanations for dispute initiation or termination, but only

¹Thompson (1995) proposes an alternate mechanism for studying rivalries that examines other factors (such as the perceptions of leaders) rather than the frequency or intensity of disputes. See Cioffi-Revilla and Sommer (1996) for a discussion of the stability of rivalries (and whether rivalries are “enduring” in a different sense).

²One view is that enduring rivalries simply represent a convenient platform for the analysis of disputes. A researcher need not assert that disputes in a series are related. Selection of enduring rivalries may simply provide a richer sample for research into the initiation or termination of disputes. We disagree. Unless disputes in enduring rivalries differ qualitatively from other dispute dyads, there is no clear theoretical rationale for distinguishing them from isolated disputes. Linking disputes in series implies a connection. Indeed, a central focus of published studies of enduring rivalry involves presentation and refinement of selection criteria designed to differentiate “relevant” from “irrelevant” disputes.

when enduring rivalries themselves alter the probability of disputes within given dyads. We close by suggesting a number of routes for advancing future enduring rivalries research.

Enduring rivalries research is one branch of a broad quantitative research program into the causes and patterns of conflict and war. Enduring rivalries examines a subset of states and their militarized disputes, since these states frequently engage in disputes. We argue that research using enduring rivalries must at least implicitly behave as if disputes in series are themselves causal. Using enduring rivalries as a sampling technique seems untenable for inference reasons. Other research on international conflict attempts to examine all states, and studies the context in which states get into disputes. Such research argues that the best way to understand international conflict is to explicitly take into account states' strategic behavior (e.g., Brams and Kilgour 1987; Bueno de Mesquita 1996; Bueno de Mesquita and Lalman 1992; Bueno de Mesquita, Morrow, and Zorick 1997; Fearon 1994; Morrow 1989; Smith 1995; 1996; Zagare and Kilgour 1993). In this view, outcomes in international relations occur because states *choose* certain behaviors. Disputes are part of an escalation process in which states act while anticipating the reactions of other countries. This discussion reflects the larger debate over using models of strategic behavior in political science.

In this article, we take no direct position on which approach is inherently superior. For enduring rivalries research to progress in the face of rational-choice or other methods of studying conflict, however, it must justify why researchers should only examine certain cases. To do so, enduring rivalries researchers must do more than point to the density of conflict events. This paper documents the flaws in examining existing lists of enduring rivalries, even if such lists appear to encapsulate many or most international disputes. Because current approaches to enduring rivalries fail to demonstrate an endogenous explanation for initial disputes in dispute series, the enduring rivalries approach remains dependent on competing explanations. Further, the approach can only be rationalized if it is shown that subsequent disputes are caused (at least in part) by factors unique to the presence of the rivalry. Disputes must beget disputes. At least in this study, we find no evidence to support such a proposition.

Literature

How have researchers determined which rivalries should be classified as “enduring?” The standard approach establishes a minimum number of militarized disputes that must take place within a specified period (Goertz and Diehl 1992, 155). An alternate approach sets a minimum number of disputes, a minimum time period for the rivalry and a maximum period between consecutive disputes.³

³Lieberman (1995) discusses the Egyptian-Israeli “enduring rivalry” (1948–79), but he does not define a rivalry.

Goertz and Diehl (1993) discuss four of the most widely referenced operationalizations of enduring rivalry. Wayman requires that two or more disputes occur between two states within a 10-year period (cited in Goertz and Diehl 1993, 159). A rivalry has ended when 10 years pass without an additional dispute. According to Diehl (1985), an enduring rivalry exists if there are at least three disputes within 15 years (cited in Goertz and Diehl 1993, 159). Disputes related to world wars are excluded to remove possible confounding issues (262 disputes). Again, enduring rivalries terminate when 10 years pass without further disputes within the dyad. Gochman and Maoz (1984) provide a list of enduring rivalry dyads, but as Goertz and Diehl (1993, 159) point out, “[t]heir operational criteria . . . are somewhat vague.” In particular, they do not make explicit, quantitative statements about dispute frequency or duration. From the list identified by Gochman and Maoz (1984), Goertz and Diehl (1993) infer a minimum criterion of 7 disputes, with no limit on the number of years. Finally, Goertz and Diehl (1993) discuss several research efforts that center around the Correlates of War Project (COW). There are minor differences within this “COW definition” group regarding the criteria for determining enduring rivalries, but Goertz and Diehl argue these differences can safely be ignored. We adopt the same approach. According to this standardized COW definition, an enduring rivalry exists if at least five militarized disputes occur between two states over *at least* a 25-year period *and* no interval greater than 10 years elapses during which there is no dispute (Goertz and Diehl 1993, 160). Once established, an enduring rivalry ends when there are no further disputes in 10 years.

Goertz and Diehl (1992) supply still another operationalization of enduring rivalries: “Enduring rivalries are those conflicts between the same two states that involve at least five militarized disputes in a period lasting at least 10 years. An enduring rivalry is considered terminated if a period of 10 years passes without another militarized dispute between the two states” (155). Like virtually all other published sources, Goertz and Diehl (1992) operationalize this definition using the Correlates of War Militarized Interstate Dispute (MID) dataset from 1816 to 1976. They find that 59 rivalries are “enduring.”⁴ In more recent work, Goertz and Diehl (1995a, 1995b) establish a slightly different definition. “An enduring rivalry is a competition between states that involves six or more militarized disputes between the same two states over a period of 20 years An enduring rivalry has ended when 15 years passes without another dispute between the parties” (1995a, 33). A total of 45 rivalries over the time frame 1816–1976 meet these criteria (Goertz and Diehl 1995b, 7). Finally, Hensel (1995, 12–13) defines

⁴ Huth and Russett (1993) study general deterrence among “enduring rivals,” using the minimum criterion akin to that established by Goertz and Diehl (1992)—five disputes. Huth and Russett (1993), however, limit their cases drastically in their attempt to focus on general deterrence. To that end, they only consider cases that (a) occurred after World War II; (b) involved governments making “claims to national (not colonial) territory, or claims in which one party rejects the other’s claims to sovereignty” (63); and (c) did not resolve the central issues for at least 20 years.

“evolutionary” enduring rivalry. Evolutionary rivalries appear promising in several respects, but we find the formulation difficult to adapt to our test.

Table 1 is a list of the attributes of various operationalizations of enduring rivalry gleaned from the literature and used in this study. In all, we examine six, attempting to incorporate prominent definitions with a wide variety of attributes. Except for that described as the standardized COW definition, each operationalization is associated with a published source in the literature. Most are characterized by the minimum number of disputes required in a given maximum number of years.⁵ Conversely, the COW and Goertz and Diehl (1992) definitions require a minimum number of disputes to occur in *at least* a minimum period of years. In both cases, these criteria are supplemented by the requirement that no two disputes occur farther than 10 years apart. This requirement allows for lulls in enduring rivalries while minimizing the prospect that separate series of disputes or individual disputes widely separated in time might be counted as an enduring rivalry. The Gochman and Maoz (1984) definition is unique among the definitions examined here in that it incorporates no time constraints.⁶

For the study of enduring rivalries to be theoretically interesting, the following question must be answered positively: Do conflicts between rivals in one period of time significantly influence conflicts in other periods of time? Earlier research provides some tentative answers. Maoz (1984) says that, “decisive outcomes and imposed settlements in previous disputes tend to produce longer intervals until the next outbreak of conflict than other types of outcomes and settlements . . . the winners of those outcomes tend to initiate the subsequent conflict” (cited in Hensel 1994, 282). According to Williamson et al. (1987), “the likelihood of subsequent conflict between the same disputants is highest soon after the previous dispute, and declines thereafter” (cited in Hensel 1994, 282).

The research discussed in the previous section also argues that a conflict between rivals in one period influences future conflicts. However, just as the literature contains variations in operationalizing enduring rivalries, so too it contains different interpretations of the meaning of the results obtained from such classifications. Goertz and Diehl (1992) find that conflicts between rivals are different from other conflicts. They conclude that “[s]cholars can no longer assume that conflicts are independent of one another and that each crisis, dispute, or

⁵Hensel (1994) eliminates the time frame restrictions included in other enduring rivalries research. For an interesting defense of this approach, see his note 3 (295). See also Gochman and Maoz (1984.)

⁶Bennett (1996, 1997) and Hensel (1994) use an alternative conception of “rivalry” to deal with the links between disputes over time. They argue that a rivalry is a durable dyadic conflict over a *single issue*. Each researcher selects cases based on this criterion. Bennett (1996, 1997) combines selection of enduring rivalries based on issues with the standard COW definition described earlier. Hensel (1994) limits his discussion to Latin American rivalries. Vasquez (1996), in his description of rivalries, emphasizes psychological factors over the issues under contention. When testing his theory, however, Vasquez uses the standard enduring rivalries approach (adopting three of the criteria previously addressed).

TABLE 1
Comparison of Different Operational Definitions of Enduring Rivalries

Reference Definition of Enduring Rivalry	Minimum Number of Disputes	Maximum Period to Satisfy Definition	Minimum Number of Years	Maximum Number of Years between Disputes
Wayman (1990)	2	10	none**	none
Diehl (1985)	3	15	none	none
COW	5	40*	25	10
Goertz and Diehl (1992)	5	40*	10	10
Goertz and Diehl (1995a)	6	20	none	none
Gochman and Maoz (1984)	7	none	none	none

*This is implied by the requirement that disputes be no more than 10 years apart.

**Goertz and Diehl (1993) indicate 11 years, but this is greater than the maximum period to satisfy the definition.

dyad has *a priori* the same likelihood of escalation to war” (161). They acknowledge the possibility, however, that other causes may exist that explain their results (162).

Hensel (1995) goes further, attempting to show why conflicts in one period are related to conflicts in other periods. Using an “evolutionary” approach, Hensel concludes that “the likelihood of conflict recurrence increases in later phases of rivalry, or that adversaries with a longer history of conflict are more likely than other adversaries to become involved in another confrontation at any given point in time” (5). We find Hensel’s results encouraging, but not surprising. Very few dyads have sufficient opportunity and willingness to engage in any military conflict. Once a dyad has overcome those hurdles, one could expect that dyad (in comparison with nonconflict dyads) to be more likely to clash. However, it does not then follow that the *disputes themselves* are directly linked causally or even that there is anything intrinsically compelling about the frequency of disputes. Researchers have been made aware of the dangers of selecting on the dependent variable. By documenting the evolutionary nature of rivalries, Hensel (perhaps unwittingly) demonstrates the need for researchers to examine all potential conflict dyads, not just those that “happen” to fight repeatedly. In the sections that follow, we critique the logic of enduring rivalries research. We develop a research design for assessing the empirical temporal assumption underlying enduring rivalries research. We then test whether enduring rivalries are valid phenomena in the statistical sense or whether they can be accounted for by standard probability theory.

Discussion

Links Through Time: The Instrumental Variable Problem

When studying enduring rivalries, it is useful to consider the broader nature of the relationship between international conflicts. One argument is that war begets war, that international disputes contribute to the disputes that follow. Subsequent conflicts may be due to prior manufacture of rage and bloodlust in belligerent societies, increased confidence on the part of the winner of previous conflicts, a grudge held by the losing side, or the loss of inhibitions toward the use of force between states. In this respect, international conflict is a causal variable as well as the subject of study. Enduring rivalries research shares this perspective with the literature on war diffusion (Siverson and Starr 1990, 1991). Where the two approaches differ is in their attention to temporal sequencing. Research on war diffusion or contagion studies the spread of international violence across nations at roughly the same point in time while enduring rivalries research assesses the effects of international violence on pairs of states through time.

The opposing argument is that wars resolve conflicts, that international disputes by their nature are forms of reckoning that constitute definitive arbitration

in the international system. Wars and lesser disputes produce outcomes that, while perhaps not entirely satisfactory to the parties involved, are nevertheless an arrangement, or rearrangement, of the *status quo* backed up by force. They are therefore less likely to be revisited than conflicts resolved through peaceful means because the previous arrangement was costly to both parties. While “the war to end all wars” may be a fiction, the majority of disputes are not reenacted.

A third alternative is that there is no relationship between conflicts. A dispute between two countries in one period may be linked or related to a dispute between them in a different period. International disputes may also appear linked when they are not. States with histories of disputes are more likely to engage in additional disputes. It does not necessarily follow, however, that previous disputes are causal. Causation is difficult to unravel precisely because disparate explanations lend themselves to the same facts. We know, for example, that contiguous states engage in more isolated disputes *as well as* in more enduring rivalries. Still, we might attribute the increase in enduring rivalries between contiguous states more to contiguity’s effect on increasing the number of initial disputes rather than in furthering any links between disputes in series.

Suppose that disputes are the result of some exogenous process. The conditions leading to disputes might be correlated through time, but what might appear as connections between the disputes themselves could in fact be due to the exogenous process. For example, the series of disputes between Israel and neighboring Arab countries could derive in part from previous disputes or they might be due largely to old precipitants that linger, unresolved. A series of disputes may not be directly related to one another, even if the series have a common cause or set of causes. This is an instrumental variable problem that may lead us to misattribute causation. Further, if disputes in a series are independent, then treating them as a unit is problematic. Suppose we remove the 1948 Arab-Israeli war from the history books. Does this decrease, increase, or leave unaltered the prospects for fighting in 1956, 1967, 1973, 1982, etc.? The problem for enduring rivalries research is that the approach assigns causation by *caveat*. Because selection criteria for enduring rivalries depends on dispute frequencies, researchers must assume that disputes lead to disputes.

To see that this is so, assume for a moment that series of dyadic disputes are not linked causally. It then becomes difficult theoretically to distinguish isolated disputes in which subsequent disputes may, but do not, occur from disputes in series. Either enduring rivalries are different from isolated disputes because the disputes are linked causally (and therefore worthy of study as distinct phenomena) or they are a biased sample of disputes that just happen to occur at similar points in time. Since the latter position denies the existence of enduring rivalries in all but the narrowest phenomenological sense, we focus on the more engaging argument, that enduring rivalries are different from isolated disputes. If distinct, enduring rivalries are so because of the apparent relationships between disputes; disputes are not statistically independent of each other. We see it as a challenge

to assess empirically this central assertion of enduring rivalries research. Before doing so, however, it may prove useful to briefly examine a second theoretical dilemma.

Examining the Initial Dispute in a Series

Unlike enduring rivalries research, typical social science approaches to international conflict emphasize cross-sectional analysis of variables thought to be causal. Wars, disputes, or other international behaviors are said to be the product of factors largely contiguous in time. Where temporal concerns do enter into quantitative analyses of international conflict, it is largely for statistical purposes, to “control” for time-series effects not central to the analyses. Enduring rivalries research correctly suggests that this approach is narrow and that better understanding of international disputes might be had through integrating explicit analysis of the temporal component. Still, current applications of the enduring rivalries approach neglect to incorporate a variety of other potential causal variables, implying that previous disputes are themselves the primary explanation of subsequent disputes within conflict dyads.⁷

Imagine the conditions typically conceived of in enduring rivalries research. States A and B engage in a series of disputes. The number of periods between disputes may vary for reasons exogenous to the argument.⁸ Disputes subsequent to the initial dispute can be explained at least in part in terms of prior disputes. The problem with this explanation of events is that there is no cause identified for the initial dispute. All enduring rivalries must begin in an initial dispute. Not all disputes are destined to touch off enduring rivalries, of course, but states that are going to be members of an enduring rivalry must pass this first hurdle. In short, initial disputes are a necessary condition for enduring rivalries. It follows that an explanation for initial disputes is necessary to explain the presence of enduring rivalries. The current enduring rivalries literature does not motivate initial disputes, however. Instead, other theories of international conflict are left to explain these events. We cannot have enduring rivalries without initial disputes; nor can we explain initial disputes using the enduring rivalries approach. Therefore, current research on enduring rivalries by itself cannot account for enduring

⁷ A notable (and recent) exception is Maoz and Mor (1996), which presents a game-theoretic analysis of the decisions made in the early stages of rivalry. We find the theoretical model and the empirical tests performed to be very promising. Maoz and Mor acknowledge, however, that the tests are both “preliminary and partial” (151). Indeed, while the model examines the early stages of rivalry, the case studies were chosen *post hoc*, and all are cases that developed into full-fledged enduring rivalries. Thus, Maoz and Mor’s analysis does not as yet address states’ decisions to become involved (or not involved) in an initial dispute. More complete tests of the model will likely address this issue more fully. One should not therefore view our critique of the “enduring rivalries literature” (in the following pages) as addressing the theoretical argument of Maoz and Mor (1996).

⁸ A period is the time length specified by the unit of analysis designated by the rivalries researcher (generally one year).

rivalries. Other theoretical explanations for international conflict must be used to account for initial disputes in series.

Enduring rivalries researchers may protest that all analysis is constrained by the need to research a manageable domain, that omitting a discussion of the causes of initial disputes is one of these compromises. Still, the problem is pervasive. If an exogenous theory is necessary to explain initial disputes, why is the same theory not sufficient to explain subsequent disputes?⁹ Suppose we allow that initial disputes are necessary to enduring rivalries and unaccounted for by theories of enduring rivalry. This suggests that any theory that can account for initial disputes is at least *a priori* a plausible explanation for other disputes in a series. But this means that theories of enduring rivalry are neither necessary nor sufficient to account for enduring rivalries. Since other explanations must exist to explain initial disputes and such explanations linger to explain subsequent disputes, enduring rivalries are not needed as an explanation for international conflict. What may remain is the possibility that theories of enduring rivalry account for *differences* between disputes in series and isolated disputes. If disputes are sometimes caused (in part) by prior disputes, then the enduring rivalries approach can account for the change in dispute probability associated with subsequent disputes in dispute series.¹⁰ Such a position fully depends on the claim that disputes in series are different from isolated disputes, however. This is a claim that is both empirical and testable.

The "Hot Hand"

The human mind has a special talent for pattern recognition. Yet, this gift for identifying associations can also be a source of error. Often, even with careful reflection, we identify patterns where none exist. Statisticians have many anecdotes about the tendency for people to impute causation from randomly generated series. Individuals presented with the results of a number of unbiased coin flips will often report patterns. The fact that relationships can be identified by imaginative observers does not demonstrate that relationships actually exist. Nor is the lack of uniformity in observations evidence against an assertion that a process is random. "Random, of course, does not mean evenly spread. Randomness comes in blots and clusters. Flip a penny a thousand times, and you'll see some long streaks of Lincolns as if that coin did indeed have two heads"

⁹In defending their broader usage of the term "rivalry," Huth, Bennett, and Gelpi (1992) make a similar point: "We do not define a rivalry solely by the frequency of militarized disputes. . . . We view the outbreak of militarized disputes as *manifestations* of a rivalry reflecting competing claims to territory, economic resources, and so on, *and not an underlying cause of the rivalry itself*" (483, n. 8; emphasis added).

¹⁰Using enduring rivalries as a sampling technique or unit of analysis is defensible only if one is comfortable asserting either that enduring rivalries are a random sample of disputes (not typically the claim) or that enduring rivalries contain properties unique from disputes in general and thus that they are worthy of study in their own right (the proposition tested below).

(O’Rourke 1994, 155). Behavior, too, can come in dribs and drabs. Athletes, though presumably always interested in achieving victory, will sometimes exceed their typical performance for short periods or occasionally “hit a slump” where they fall consistently below average. Veteran card players often hope that fortune will intercede on their behalf with an unusually favorable series of cards. Such “hot hand” effects are widely identified in areas of human activity involving risk, uncertainty, or costly contests.¹¹

What is less clear is the causal nature of hot hands. Many who observe series of low-probability events in relatively close succession are convinced that what they see is just too unlikely to be the product of chance. Still, probability theory tells us that improbable strings of nonassociated events can occur, often with greater frequency than we might suspect (Hogg and Craig 1995). If we are to be confident that a series of events are linked causally, we must show that the events occur in a manner that is significantly different from a series of unrelated events. To assess whether disputes in enduring rivalries are related causally, we must determine if similar frequencies of dispute series can be generated using a stochastic process.

One way to do this might be to determine whether initial disputes in series increase or otherwise alter the probability of subsequent disputes. Efforts have begun in this direction (Hensel 1994). Unfortunately, this approach involves a counterfactual comparison. We must ask what a given enduring rivalry would look like were the disputes to be independent of one another. The problem is that we do not know the underlying dispute probability in specific small samples in the international system. Other samples that might be used for comparison cannot form an adequate test because enduring rivalries are already selected for their atypical dispute frequency. Series of disputes identified as enduring rivalries do in fact demonstrate a greater likelihood of subsequent disputes, but this would be true whether or not disputes were related. Dyads containing enduring rivalries are selected *because* they have many disputes.

Imagine a population of low-probability events distributed at random. The probability of a dispute in any given dyad year is independent of disputes in other dyad years; but this does not, of course, mean that all dyads of a given number of years will have the same number of disputes. Some dyads will contain several disputes while others have few or none. For dyads that have had x disputes, what is the probability of another dispute in any given year? The probability will be higher than for the calculation on an earlier sample—the probability of another dispute for those dyads with $(x - 1)$ disputes. This occurs because of selection. We have removed from the sample dyads based on the posterior probability of disputes. Suppose we compare the probability that a given flip of a penny is heads in two samples. The first sample contains the results of

¹¹ Other researchers point to the “hot hand” phenomenon, though in a different context (Goertz and Diehl 1995b).

a large number of tosses of the penny—say, one thousand. The odds in the first sample of observing heads as the result of any given toss should approximate one in two. In the second sample, we withdraw from the results of the first sample any series of two or more tosses of tails. Though we know that the unbiased coin we have been using generates equal odds of heads and tails, the probability that the results of any given flip in the second sample is heads is now well in excess of 1/2. We might infer that the presence of other tosses of heads has led to this increase in the probability that the results of any given toss are heads in the second sample. We would of course be correct, but this is caused by sampling and not by any relationship between the pennies.

Because the use of conditional probability involves comparisons with counterfactuals, we examine another aspect of disputes, their systemic distribution. In a system relationships change the way events are distributed. Enduring rivalries research points out that many disputes occur in series (as many as 45% of all disputes, according to Goertz and Diehl 1995a, 32). If a major portion of the disputes in the international system are related, then the proportion of disputes observed in dispute series should be relatively high. Observable dispute series should exceed what we would expect to see generated by a system in which disputes do not possess significant relationships. Indeed, this is exactly the conclusion Goertz and Diehl reach in the study cited above. The international system may be generating high-frequency series of low-probability dispute events, but Goertz and Diehl suggest that the number of such series exceeds what we would expect unless many of the disputes in the system are related. In the next section we develop a statistical test to assess their intuition.

Analysis

In this section, we test whether militarized disputes in series, characterized as enduring rivalries, are most likely the product of a process lacking significant temporal association. Goertz and Diehl (1993) argue that the number of enduring rivalries they identify is too large to be an artifact of systemic chance. We employ the Poisson distribution to assess this claim.¹² The Poisson is a model that others have used to examine the randomness of different international events

¹²The Poisson is a good approximation of the binomial distribution when events are rare. See Hogg and Craig (1995) or Rice (1988) for a full discussion of the Poisson distribution. Our situation may also be considered a special case of a Markov process (see Olinick 1978, chap. 10). We use the Poisson because its interpretation is clearer in this context. See Duncan and Siverson (1975) for an application of the Markov in international relations. The Markov is appropriate when the future state is dependent only on the present. In the rivalries context, this means that the probability of a dyadic dispute at time $t + 1$ depends only on whether there was a dispute at time t and is independent of the dispute status at time $t - 1$. A Markov approach is suited to modeling rivalries if we assume disputes in series are *not* independent. It does *not* apply as well as the Poisson to our needs since our null model requires that the probability of a dyadic dispute is independent of previous disputes in each time period.

(e.g., Bremer 1980; Davis, Duncan, and Siverson 1978; Levy 1982; Midlarsky 1984). In the Poisson, the probability of an event in a given time period is fixed—that is, the probability of the event does not change over time. The Poisson model thus allows us to imagine a world in which there is a certain probability of dyadic conflict every year, year after year. Even in this world, chance will create some dyads that engage in disputes frequently. The Poisson allows us to calculate the number of ersatz “enduring rivalries” produced by random chance.

The distribution takes the following form:

$$P_{(Y_t=k)} = \frac{(\lambda t)^k (e^{-\lambda t})}{(k!)}, \text{ where } \lambda > 0 \text{ and } k = 0, 1, 2, \dots$$

The formula determines the probability of k events occurring within t periods. The model assumes that events to be counted (k 's) are independent from each other, exactly the behavior we wish to imitate.

To conduct a test, we must identify a sample of all dyads that might potentially generate an enduring rivalry.

First, we select all dyads represented in the Correlates of War (COW) Interstate System Membership dataset that possess at least one dispute. A dyad that has no disputes has no chance of becoming embroiled in an enduring rivalry, while a dyad with at least one dispute may or may not contain any enduring rivalries. Thus, an initial dispute is a necessary but by no means sufficient condition for enduring rivalry. This is most likely similar to the method of enduring rivalries researchers themselves, since no dyad in which disputes do not occur is likely to be reviewed to see if other criteria are met. Identifying all dyads in which at least one Militarized Interstate Dispute (MID) has occurred also most nearly selects cases that possess both “opportunity” and “willingness” to engage in conflict (Siverson and Starr 1990, 1991).¹³ Second, cases are annualized dyads following and prior to the first dispute based on membership of both states in the international system. Beginning and ending dates for system membership come from the COW Interstate System Membership dataset. Third, dyad years may be censored from the dyad for any of four reasons:

1. If either or both states cease to be members of the interstate system, the dyad is censored in the year in which this occurs.
2. If the contiguity circumstances as indicated by Siverson and Starr’s indicators change (indicating that opportunity has been removed) and no additional MIDs are recorded, the dyad is censored in the year in which this occurs. This

¹³Paul Hensel provided the MID data used in this study. The data cover the period 1816–1976 and are the same as those used in the studies analyzed here. Hensel modified the original Gochman and Maoz (1984) dataset to represent cases of disputes at the dyadic level. We use the original MID data rather than the newly revised version (Jones, Bremer, and Singer 1996) to more accurately critique existing studies (that also use the earlier dataset).

condition is relevant in only a small number of cases. Including these cases does not dramatically alter the results, but we think that censoring more nearly reflects the nature of opportunity and willingness. Both opportunity and willingness appear to be contributors to conflict, so that the removal of either makes conflict much less likely. For example, Spain's departure from Latin America as a result of the Spanish-American War makes it difficult to imagine an enduring rivalry evolving between Spain and Mexico. Since there are no additional disputes recorded between the two countries, the Mexico–Spain dyad is censored in 1898. Another way to think about this is that we simply reassess the original requirement that a dispute occurs on any dyad in which opportunity appears to have been removed.

3. If a dyad exists for more than a generation (20 years) prior to the first dispute in the dyad or 20 years after the last dispute in the dyad, the dyad is censored 20 years before the first dispute or 20 years after the last dispute.¹⁴
4. All cases are terminated in 1976, the last year included in the studies of enduring rivalries examined here.

These conditions produce a sample of 20,718 dyad years. This sample is almost identical to samples identified by other researchers (Anderson and McKeown 1987; Maoz 1984). Fourth, we divide the number of MIDs (1,529) by the number of potential dyad years of conflict to estimate the probability of a dispute in a given dyad year. The probability that an individual dyad year contains a dispute is λ in the Poisson formula.

In choosing our sample, we intend to construct a rigorous test while being fair to the enduring rivalries approach. An alternative sample is the so-called “politically relevant dyads,” major-power and contiguous dyads. We reject the use of politically relevant dyads in this study because the sample omits (or “unpredicts”) 26% of the militarized disputes (Maoz and Russett 1993, 627), while including a large proportion of dyad years in which states apparently possess opportunity to dispute, but not willingness.¹⁵ As such, a sample of politically relevant dyads possesses some of the same shortcomings we attribute to samples of enduring rivalries. Because all enduring rivalries researchers agree that an initial

¹⁴The choice of 20 years is admittedly arbitrary, but it is not without rationale. A lapse of a generation provides a break in the continuity of elements that enduring rivalries researchers (as well as others) point to as causes of temporal association between disputes. Second, 20 years is the longest time constraint specified in the enduring rivalries literature and is at least as long as any specified period for establishing the termination of an enduring rivalry.

¹⁵Readers may be curious as to why we appear to reject the contiguity criteria in “politically relevant dyads” while employing contiguity as part of our censoring rules. There is nothing inherently wrong with using contiguity factors in selecting cases for study. However, it would be inappropriate for our sample to adopt *only* the “politically relevant dyad” criteria of contiguity and major-power status, as these represent only opportunity and not willingness. We view contiguity as necessary but not sufficient for rivalry. We therefore use the contiguity criterion only as described in our censoring rules: when a dyad changes its contiguity status and no further disputes occur, we remove the dyad at the point when contiguity changes.

dispute is necessary for an enduring rivalry, and because the existence of that initial dispute suggests the states possess both opportunity and willingness, we believe that our hybrid sample better exhibits the conditions we seek to represent in the null model. Additionally, our construction may appear controversial since we include all dyads that were participants in multiparty conflicts (without identifying the key participants). Including these (non-major power, noncontiguous, non-key party) dyads in our sample, however, biases *against* our hypothesis that apparently "enduring" rivalries are the result of sequences of random dyadic disputes. Both factors tend to inflate artificially the number of dyads that could potentially become enduring rivals.

From the dispute probability statistic, we determine the odds of producing series of dyad years that satisfy the conditions set by definitions of enduring rivalry. This is done using a Poisson process, where k is the number of disputes, t is the number of years, and λ is the probability of conflict per dyad year (calculated as above). Operational definitions of enduring rivalry differ from researcher to researcher and even from publication to publication. For this reason, we have run our test on six different definitions provided by the enduring rivalries literature: all four of the operationalizations of enduring rivalry identified in Goertz and Diehl (1993)—the Correlates of War (COW) group, Gochman and Maoz (1984), Diehl (1985), and Wayman (1990; cited in Goertz and Diehl 1993); the criteria provided by Goertz and Diehl (1992); as well as the more recent operationalization found in Goertz and Diehl (1995a). By doing so, we attempt to provide a thorough coverage of the literature. We hope also to avoid the criticism that we have acted arbitrarily in identifying a subject for our test.

We do not know *a priori* which dyad years contain initial disputes. However, every dyad year is *potentially* the beginning of an enduring rivalry. Therefore, to find the number of "potential" enduring rivalry time periods, we calculate the number of time periods satisfying various operationalizations of enduring rivalry that exist for every dyad in the system. Of course, we do not know which of these might manifest into actual enduring rivalries. However, we do know how many of them could *potentially* be enduring rivalries. We treat each year in a dyad as the first year in a potential enduring rivalry, with the exception of the last few years of the dyad (when an "enduring" rivalry by definition could not begin for lack of time). We remove 10, 15, or 20 years from the end of each dyad, depending on the requirements specified by the appropriate operationalization of enduring rivalry.

Three of the definitions require modifying this procedure slightly. Goertz and Diehl (1992) and the COW definition do not specify a maximum time period. Instead, a minimum time period is specified, along with a requirement that consecutive disputes in a series not be separated by more than 10 years without a dispute. For these definitions, the minimum time period acts as a constraint on the number of potential enduring rivalries. Dyads with less than the minimum number of years together are automatically disqualified from containing an

enduring rivalry. In addition, depending on the definition, either the last 10 or the last 25 years of any dyad are removed. These years cannot contain an initial dispute in an enduring rivalry since there would not be enough years remaining to satisfy the minimum length requirement. The dyad years that remain each represent a remote possibility that an initial dispute of an enduring rivalry will occur. There are many of these years, however, and the number of enduring rivalries expected from the statistical model is the sum of the probabilities for all dyad years. In order to establish an estimate of this probability, we subtract from unity the probability that there *will not* be an initial dispute in a given dyad year, the probability that there *will* be an initial dispute in that year but not at least one more in the next 10 years, and the probability that there will not be at least four more disputes in the time remaining.

Gochman and Maoz (1984) give no indication of the time length of enduring rivalries. They instead imply that any given *dyad* is potentially an enduring rivalry, depending on the number of disputes that occur. In order to test this definition, for each of the 546 dyads identified in our sample, we calculate the probability that at least seven disputes occur. Assuming that each dyad year is equally capable of containing a dispute, the probability of seven or more disputes in a dyad will depend on the number of dyad years in the dyad. We calculate the Poisson probability that the dyad will not meet the conditions of the definition for each dyad and subtract this from unity. For example, the probability of a dyad that exists for only six years satisfying the Gochman and Maoz (1984) definition is zero, while the probability of meeting the conditions of the definition approaches 95% (~5% that the dyad will not) for a dyad that exists for more than 160 years. We then sum the probabilities across all dyads to arrive at an estimated number of enduring rivalries within the sample.

Calculating the probability that a random series of dyad years meets various operationalizations of enduring rivalry means we can then estimate the number of enduring rivalries that would be generated by the null model. We multiply the number of potential enduring rivalry time periods by the probability that a given time period contains the number of disputes needed to qualify as an enduring rivalry. For each operationalization, we simply multiply the probability generated by the Poisson model by the number of periods calculated in the previous section. The result is an estimate of the number of enduring rivalries that are produced by a system known to possess no temporal association between disputes.

Results

We summarize the results of our analysis in Table 2. In some cases there is a striking similarity between the results of the null model and the number of enduring rivalries reported in the literature. In other instances, the null model generates numbers of enduring rivalry that are much larger than those found by enduring rivalries researchers. These numbers may seem remarkable initially, but

TABLE 2
 Comparison of Enduring Rivalries Predicted by a Poisson Process
 and the Number Identified by Definitions of Enduring Rivalries

Reference for Definition of Enduring Rivalry	(A) Number of Dyad Years	(B) Probability of Dispute (1,529 MIDDs)/(A)	Probability of Meeting Rivalry Definition [(B) × cond. logic]	Number of Potential Enduring Rivalries [(A) – ineligible]	Number of Identified using Rivalry Definitions	Number of Predicted by Poisson Distribution
Wayman (1990) (at least 2 disputes in at most 10 years)	20,718	0.074	0.169	15,885	276	2,686.4
Diehl (1985) (at least 3 disputes in at most 15 years)	16,858	0.075*	0.105	10,637	148	1,118.5
COW (5 disputes in at least 25 years [40 max])	20,718	0.074	0.005	9,041	30	49.5
Goertz and Diehl (1992) (5 disputes in at least 10 years [40 max])	20,718	0.074	0.005	15,885	59	87
Goertz and Diehl (1995a) (at least 6 disputes in at most 20 years)	20,718	0.074	0.004	11,001	45	45.4
Gochman and Maoz (1984) (at least 7 disputes with no time limit)	20,718	0.074	0.000 to 0.951	546**	52	52.8

*The definition used by Diehl (1985) censors disputes associated with the two world wars, resulting in 1,267 usable MIDDs.

**The number of dyads in the sample. Gochman and Maoz (1984) do not specify a time constraint, so each dyad is a potential rivalry.

recall that the test criterion is only specified in terms of ordinal differences. To reject the hypothesis that disputes are independent events, definitions of enduring rivalry need to report a significantly higher number of disputes than is generated by the null statistical model. The results show the opposite. The null model estimates a number of random series satisfying various definitions of enduring rivalry that are either similar to or exceed the number of enduring rivalries identified by enduring rivalries researchers. We cannot therefore reject the hypothesis. Instead, our test suggests that the number of dispute series identified as enduring rivalries is in fact consistent with the number generated by a stochastic process. Note, however, that definitions of enduring rivalry that require the greatest number of disputes are most nearly equivalent to our null estimate of enduring rivalries. Thus, definitions of enduring rivalry that require a higher number of disputes could help to defeat the Poisson findings, and document that disputes are not independent over time.

Conclusion

Our statistical model is a crude device. We would not like readers to put much stock in the significance of metric values or even treat as too serious the overall implication of the test. It would be precipitous to claim that enduring rivalries do not exist.¹⁶ We think that further study is warranted and hope that our efforts stimulate enduring rivalries researchers and others to further assess the approach. Still, it seems to us remarkable that a model intentionally constructed so that disputes are unrelated so nearly replicates observed series of disputes. In most cases the number of ersatz enduring rivalries produced by the null model is almost the same as that identified by the literature on enduring rivalries.¹⁷

We wish to emphasize that of all the calculations, the work by Goertz and Diehl (1995a) is most nearly the same as the estimate given by the null model. Goertz and Diehl (1993, 1995a) point out shortcomings in previous enduring rivalries research and incorporate many of their comments into their own evolving definition of enduring rivalry. In particular, they require the highest number of disputes per time period. Our analysis seems to support their use of this more stringent criterion. Indeed, we think that one direction for future enduring rivalries research is the use of a substantially higher minimum number of disputes. The higher the constraint on the minimum number of disputes required by the enduring rivalry definition, the more nearly our estimate and observations using the definition coincide.

¹⁶This is particularly true given the lively theoretical debate over rivalries (Bennett 1996, 1997; Hensel 1994, 1995, 1996; Maoz and Mor 1996; Thompson 1995; Vasquez 1996).

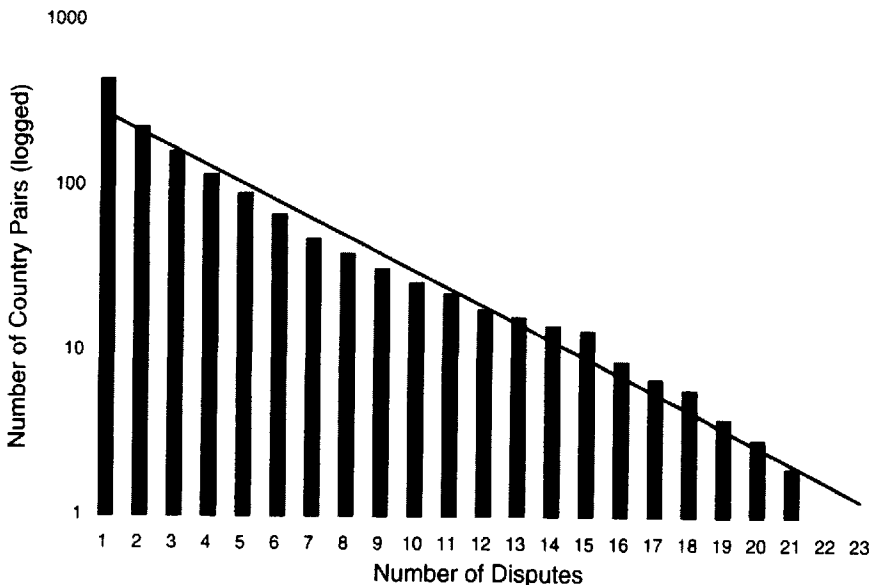
¹⁷We provide no tests of the significance of the difference between the numbers of enduring rivalries reported in the literature and those generated by our null model. We believe such tests would imply a false robustness to our results. Standard significance tests imply that the metric distance between two numbers is meaningful. Results of the statistical model are not precise enough to allow for this type of inference.

Figure 1, entitled “Histogram of Logged Dispute Frequencies,” shows the total number of dyads (country pairs) engaged in various numbers of disputes. The data are drawn from the MID dataset. Each column represents the number of country pairs that engaged in *at least* the specified number of disputes. For example, about 100 pairs of states are identified by the MID dataset as having five or more disputes. As the number of disputes increases, the number of disputants declines. The relationship between the number of dyads and the number of disputes is roughly that of exponential decay (hence the rationale for logging the vertical axis). Notice, however, that the pattern is actually slightly more complex. The number of country pairs slightly undercuts the trend for lower values of disputes and moderately exceeds the trend when the frequency of disputes exceeds 13. It is possible that the modest shift to the right in the number of country pairs engaged in various numbers of disputes is the product of a small relationship between disputes. If this is the case, then it supports the arguments made by enduring rivalries research, but only to a degree. Future efforts should perhaps focus on a higher minimum dispute threshold in definitions of enduring rivalry.

The enduring rivalries literature argues that since a small number of dyads are responsible for a disproportionate share of militarized disputes, those dyads deserve particular study. There is nothing inherently wrong with listing those dyads and identifying them for particular scrutiny. Our quarrel is with the way that the

FIGURE 1

Histogram of Logged Dispute Frequencies



enduring rivalries literature has chosen to identify that “small number of dyads.” The laws of probability ensure that some dyads will engage in conflict more often than others. Since conflicts are rare, it might appear that those conflict-prone dyads are substantively different from other dyads. We show this to be untrue. Using the Poisson model, we show that an alarmingly simple international system (where the probability of a dispute between any pair of countries is the same, year after year) produces at least as many “enduring rivalries” as is claimed by the literature. For researchers to continue to use lists of enduring rivalries as their universe of cases, they need to document that these lists are not arbitrary. Yet, in order to make generalizable statements about international conflict, enduring rivalries researchers must show that the dispute sequences they study are symptomatic of the larger question of the causes of conflict. Research on enduring rivalries has in the past implicitly been able to claim both positions. Researchers have used enduring rivalries as a convenient sampling technique for studying conflict generally even as students of enduring rivalry developed lists based on the claim that enduring rivalries are different from isolated disputes. We hope we have demonstrated reason for caution about either application of enduring rivalry.

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