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Conditional Probability Analysis of Dyadic Interactions in the Middle East

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Kristi Nicole Bogle — Scholar

~~Dr. David Brulé~~ Dr. Thomas Burman — Mentor

A Conditional Probability Analysis of Dyadic Interactions in the Middle East — Project Title

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A Conditional Probability Analysis of Dyadic Interactions in the Middle East

Kristi Bogle

COLLEGE SCHOLARS

SENIOR THESIS

DEFENDED JULY 25, 2007

Mentor: Professor Thomas Burman
Research Advisor: Professor David Brulé

Introduction

In recent years, scholars and policy makers have become increasingly interested in various techniques of political forecasting (Bueno de Mesquita, 1998; Gaddis, 1992 – 1993, Ray and Russett, 1996). The logic of theories and theory-testing implies that the ultimate aim of science is to explain, predict, and ultimately exert control over events (Lakatos, 1970; Gaddis, 1996; Bueno de Mesquita, 1996). If a given outcome is associated with some factor across a large number of historical cases, we should expect the same relationship to occur in the future. Consequently, the future may serve as arbiter of theoretical controversies, contributing to scientific progress (Ray and Russett, 1996).

Although theoretical accuracy is beneficial for the accumulation of scientific knowledge, it is also useful for policy makers in anticipating likely scenarios and formulating policy. But much of the international relations conflict research focuses on causal mechanisms for war located at the national or dyadic level. For example, such factors as military capabilities, alliance relationships, and domestic regime type are thought to influence the probability of conflict between a pair of states (Wayman, 2000: 219 – 234). These studies tend to overlook systemic distributional patterns of international conflict behavior as well as conflict interdependencies that may lead to the widening of wars (e.g., contagion) or the onset of concurrent conflicts (exceptions include Mintz and Schrodt, 1987; Schrodt and Mintz, 1988). In other words, conflict itself may cause more conflict – international disputes may create opportunities for other states to enter an existing fray or initiate an additional dispute to make changes in the

international status quo. Yet relatively little research has sought to gauge the influence of conflict on subsequent conflict. To what extent are conflicts independent of each other? That is, do states decide to act without taking into consideration the actions of states around them? In contrast, to what extent are conflicts interdependent? What do these interactions indicate about the future of Middle East conflict?

To address these questions, I examine conflict interactions among Middle Eastern states within the context of the Cold War and post-Cold War structures using conditional probability analysis. The idea of being able to predict future political events based on the current political actions of states is consistent with the logic of other theoretical approaches as well as intuitively appealing. According to Schrodt and Mintz (1988), "there is a solid theoretical basis for assuming that the policy actions of one nation depend on those of other nations." For example, a prominent theoretical approach rooted in conditional probability as a method of analysis is Richardson's arms race model (Schrodt and Mintz, 1988: 218). This theory was developed during the Cold War era, and its basic idea is that having a large supply of weapons makes a state more war-prone, and the decisions and actions of a given state are greatly affected by another state's decision to build up their arms (Richardson Arms Race Model, 2002). Accordingly, Richardson's theory exploits conditional probability analysis by taking into account the interdependence of decision making among states.

It is also intuitively plausible to say that states not only take the political activities of other individual states into consideration when making policy decisions; they are also significantly influenced by the dyadic interactions that occur among their neighbors and within their region, as well as within the broader international political system. Thus,

rather than simply analyze national or dyadic behaviors, I study a variety of international interactions within the Middle Eastern subsystem as a whole. By using the conditional probability analysis method, I should be able to determine, based on my observations of the Middle East, whether or not this technique can be used to make political predictions in all types of international conflict.

This conditional probability analysis will address two major issues. First, I assess the extent to which the occurrence of one dyadic interaction affects the probabilities of other interactions in the subsystem.[1] Second, I use the results to explore implications for Middle East conflict in the future.

In the next section, I will utilize a literature review to better illustrate the origins of this movement in political science towards conflict analysis as a means of forecasting. I will then move to a discussion of the theory behind the hypothesis, followed by a section outlining the data collection and analysis process used in this project. Finally, I will discuss the results and conclude.

Literature Review

The purpose of theories is to explain and – by implication – predict phenomena of interest (Ray and Russett, 1996). A bold few political scientists have developed frameworks to deal with prediction, typically referred to as political forecasting (Bueno de Mesquita, 1984). According to John Gaddis (1992 – 1993), political science has yet to produce an international relations theory that can consistently predict future political

[1] A *directed dyad* refers to a pair of states in which one state is identified as the initiator and the other state is identified as the target.

events. In 1948, Morgenthau, the father of political realism, wrote that "trustworthy prophecies in international politics would never be possible, because contradictory theories would always be present in every political situation: which of them would prevail was anybody's guess (Gaddis, 1992 – 1993: 7)."

According to Waltz, "to explain how peace can be more readily achieved requires an understanding of the causes of war."[2] "In recent years, there has been increasing interest in the quantitative international relations community on the analysis of international events (Schrodt and Mintz, 1988: 217)." There has been a movement to understand and analyze individual events rather than relying solely on "measures such as power, development and status (Schrodt and Mintz, 1988: 217)." Efforts to make sense of the data are increasingly included in under the rubric: causal mechanisms for war. There are several causal mechanisms for war that are studied in international relations including alliances, capabilities, rivalries, territories, and arms races (Vasquez, 2000). All of these factors depend on a variety of conditions, and democracies act differently than non-democracies in some situations. So, these factors do not cause war anytime and anyplace, but under the right conditions, can, in fact, lead to conflict.

Alliances lead to war when a conflict occurs between two states, and as a result, several outside states are brought into a conflict simply because they have a formal alliance with one of the two states involved in the original conflict (Maoz, 2000: 111-145). Capabilities cause war when a state overestimates their own capabilities, underestimates the target state's capabilities, or does both simultaneously, when deciding to go to war (Leng, 2000: 235-280). Rivalries cause conflicts, and a majority of conflict between two states is followed by another conflict between the same two states. There are

[2] Quoted in Gaddis, 1992-1993:9

many factors that could contribute to such rivalries, like territorial disputes or nationalism, but what is important I that these rival states will most likely engage in conflict periodically (Wayman, 2000: 219-234). Territory causes conflict for obvious reasons. If two states believe the same territory belongs to them, war is likely to result. Finally, arms races are important causal mechanisms for war. It is important to note that aside from the use of nuclear weapons in World War II, there has not been any type of conflict that could be categorized as a "nuclear war". However, conflict has occurred as a result of the race for nuclear weapons or the threat of use of nuclear weapons.

In spite of criticism of the ability of social science to predict the future (Gaddis, 1992 – 1993), future interactions among states have been a common focus in political science (e.g. Bueno de Mesquita, 1986; Mintz and Schrodt, 1988; Ray and Russett, 1996). For example, expected utility theory is one method used in political science to predict future state interactions. Developed in economics, this theory "involves mathematical, deductive models applied to broad questions of political analysis, combined with the use of the detailed knowledge of expert analysts, to offer strategies and answers directly relevant to forecasting problems" (Bueno de Mesquita, 1984: 227). Its origins in economics can be seen in the following formula used by Bueno de Mesquita to calculate the expected utility of players in a given political situation (Bueno de Mesquita, 1984: 227):

Expected Net Gain = (Probability of Success)*(Available Policy Gains) + (Probability of Failure)*(Possible Policy Setbacks) + (Net Marginal Expected Impact of Third Parties)

Expected utility theory takes into account expert opinions on political matters while also "provid[ing] an ability to answer 'what if' questions by varying data inputs and performing alternative simulations" (Bueno de Mesquita, 1984: 231).

Compared to expected utility, a more intuitive approach to prediction is conditional probability (Schrodt and Mintz, 1988; Avenhaus, et al., 1989). The general expectation of conditional probability technique is that the probability of a phenomenon occurring will be different (more or less) than the unconditional probability of observing that phenomenon. Interactions between pairs of states may be characterized by the conditional probability $P(A/B) = P(A \& B)/P(B)$; where A is the occurrence of an interaction from X directed toward Y([X → Y]) and B is the occurrence of an interaction by nation M directed to nation N ([M → N]). Schrodt and Mintz (1988) point to three possibilities. First, the probability of an interaction in one dyad will be greater when there has also been an event in another dyad, or $P(A/B) > P(A)$. Second, the dyadic events may be independent; that is, $P(A/B) = P(A)$. Finally, the occurrence of an event in one dyad may decrease the possibility of an occurrence of an event in another (saturation effect); $P(A/B) < P(A)$.

Practically anything can be regarded as the conditioning, or "given," factor. Indeed, much of the multiple variable regression work is rooted in the idea of conditional probabilities – or at least conditional means (Schrodt and Mintz, 1988). The main difference between statistical research and more basic conditional probability analysis is that the latter typically identifies only one concept or general class of events to measure and assess – e.g., types of interactions, previous behavior, erosion, etc. In one study rooted in the conditional probability method in political forecasting (Avenhaus, et al.,

1989), the authors observe that President Kennedy predicted the probability of war between the United States and the Soviet Union to be between 1/3 and 1/2 (Avenhaus, et al., 1989: 91). Presumably, the President did not use any kind of systematic approach in making this prediction, and other world leaders have made similar types of predictions, also without any type of rigorous approach. Using a conditional probability analysis based on a constant reduction factor, a non-constant reduction factor, changes in the starting probability of nuclear war, and the reduction factor after that first year Avenhaus and colleagues (1989: 92) concluded the following: there will most likely always be a possibility of nuclear war, but it decreases every year; the occurrence of nuclear war is highly unlikely, and if it does happen, it is a significant amount of years away from happening (Avenhaus, et al., 1989: 99). So far, this prediction has proven to be accurate.

In another study rooted in conditional probability analysis, Schrodt and Mintz (1988) applied the technique to international conflict in order to attempt to make predictions about the political future of a specific region. Using six Middle Eastern countries from 1948 to 1978 in their analysis (Iraq, Syria, Jordan, Saudi Arabia, Kuwait, and Iran), Schrodt and Mintz (1988) found that Kuwait was "effectively a pawn, and hence it is attractive as a target of threats (e.g., from Iraq)" (Schrodt and Mintz, 1988: 228). Iraq's aggression towards Kuwait in the nineties was the cause of the Gulf War, and was, in effect, predicted by this analysis.

The basic hypothesis of Schrodt and Mintz's study is that "dyads have substantially greater possibilities of interaction when there are other dyads interacting in the system. This pattern of interdependence indicates that certain interactions in the system are more likely to set off interactions than others" (Schrodt and Mintz, 1988:

223). Units in a system of any kind are not independent of each other. That is, states do not often make decisions without first being influenced by the actions of another state or without taking into consideration the possible implications of their decision. The interactions of pairs or groups of entities affect the interactions of other pairs or groups of entities as a general principle. The current project takes Schrodt and Mintz (1988) as a point of departure and seeks to partly replicate and update their findings using a different data set and more states.

Theory

The main hypothesis of this project is that dyadic interactions are interdependent. In this study, the term *interdependence* refers to the way in which states in a system interact with each other; that is, how the actions of one state affect the actions of another. Essentially, a dyadic interaction in a given system will most likely result in action among other dyads in that same system. One conflict between two states is likely to set off one or more conflicts among other dyads; this type of interaction can be compared to a chain reaction effect. Because of this interdependence, a particular conflict is rarely contained in one dyad. Rather, any type of political action may very likely permeate an entire system.

One simple example of this type of interdependence can be found in a typical office setting. Assume that there is an office manager, a secretary, and several employees. If the office manager and the secretary have some type of interaction, other pairs of individuals in the office may interact as well. For instance, if the secretary complains to

the office manager about being mistreated by other employees in the office, several types of interactions may occur. First, this could set off individual interactions between the office manager and other office employees about the issues brought to the manager's attention by the secretary. It could also set off interactions between office employees and the secretary, because the office employees could be unhappy with the secretary's decision to "report" them to the manager. Separately, the original interaction between the secretary and manager can also cause other pairs of employees to interact among themselves. One pair of employees could have some type of interaction that involved them being unhappy with the secretary's actions. Another pair of employees might have an interaction in which one employee attempts to outperform another employee, because they might be worried about their job security as a result of the secretary's complaints to the manager.

The "office" analogy can be applied, on a larger scale, to interactions among dyads on the international stage. Schrodt and Mintz outline six types of interactions. They are reciprocal interaction, actor initiation, target initiation, actor reaction, target reaction, and remote reaction (Schrodt and Mintz, 1988: 223), and they can also be found in Table 1. The reciprocal interaction pattern refers to one state (country X) targeting another state (country Y), with the targeted state (Y) retaliating against the original actor (X). One illustration of the reciprocal pattern is Iraq's (X) invasion of Iran (Y) in 1980. In response, Iran attacked Iraq, beginning the Iran-Iraq war, which lasted until 1988. Another type of interaction is the actor initiation pattern. This pattern is characterized by Country X first attacking Country Y and then attacking some third country – Country M. One example of this can be found when the United States (X) initiated disputes with

Russia (Y), Iran (M), and Iraq (M) all in 1997. The target initiation pattern is found when Country X attacks Country Y, and Country M then also attacks Country Y. An example of this is the Yom Kippur War of 1973 in which the Syrians (X) and Egyptians (M) attacked Israel (Y). The actor reaction pattern is when Country X attacks Country Y, and Country M attacks Country X. This characterizes the events of the Gulf War in the 1990s. Iraq (X) attacked Kuwait (Y), and the United States (M), in turn, attacked Iraqi forces. The target reaction pattern is seen when Country X attacks Country Y, and Country Y attacks Country M. This was illustrated in 1990 when Iraq (X) targeted Israel (Y), and Israel then initiated a dispute against Jordan (M). The final interaction pattern is remote reaction. This pattern is found when Country X initiates against Country Y, and Country M initiates against Country N. One example of this is in 1983, when the United States (X) targeted Iran (Y), and Syria (M) then initiated against Israel (N). These six patterns of interdependence encompass all possible interactions among states and dyads.

The application of the conditional probability approach to political forecasting first requires the collection of all recorded interactions between each dyad in a system. Once the data have been collected, the number of conditional probabilities being analyzed must be determined. In the Middle East example, Schrodt and Mintz (1988) were looking at 30 directed dyads. "The probability of an interaction in any dyad can be conditional on any of the remaining 29 dyads, and thus we are examining a total of 870 (30 X 29) conditional probabilities" (Schrodt and Mintz, 1988: 222). Once this has been determined, the six possible patterns of interactions are applied to each set of conditional probabilities to examine the interdependence patterns of the system. In the next section, I describe this process in greater detail.

Data and Methods

In this study, 110 total directed dyads are being observed over a period of 22 years for a total of 2420 dyads. We are examining 11990 (110 X 109) conditional probabilities. Following Schrodt and Mintz (1988), I computed unconditional probabilities for each dyad and then conditional probabilities for each type of interaction. I used a difference in means test to determine whether there is a significant statistical difference between the average unconditional and conditional probabilities. Using the mean probabilities of each pattern, I also conducted a *t* test to determine if any individual pattern is representative of international events in general.

I use the Militarized Interstate Dispute (MID) data set (Ghosn, et al., 2001) to identify conflict interactions among the United States, USSR/Soviet Union, Iran, Iraq, Egypt, Syria, Lebanon, Jordan, Israel, Saudi Arabia, and Kuwait from 1979 to 2001. Table 2 lists all of the states involved in this research and shows a basic ratio of all of the times a state was the initiator versus the target in the aforementioned time period. This study is based on the interaction of dyads, meaning a pair of states. To speak of a directed dyad refers to the direction of an interaction within a dyad; that is, the initiator and target are identified within the dyad. The MID data set determines which state in a dyad (X or Y) is the initiator of the conflict by looking at which party was responsible for the first recorded codeable action. So, a state can be considered the initiator of a conflict by simply making a formal threat to use force; an actual use of force is not required.

Among the directed dyads made up of the states found in Table 2, we aggregated incident frequencies by year, which can be found in Table 3. The MID data set records the highest level of hostility reached in each directed dyadic interaction, ranging from 1 to 5. A hostility level of 1 indicates that a state was targeted but did not reciprocate. Hostility level 2 indicates a threat to use force, while 3 indicates a display of force. Level 4 is an actual use of force, and level 5 is war (Ghosn, et al., 2003). It is important to note that an action such as a bombing of a military base was considered equal to a full-scale war or invasion in this study. In other words, a conflict with a hostility level of 1 was computed equally with conflicts of higher levels. Every conflict in this study carried the same weight in my calculations.

Using the incident data, I calculated the probabilities for seven different patterns: Unconditional probability, reciprocal interaction, actor initiation, target initiation, actor reaction, target reaction, and remote reaction. To calculate the unconditional probability of interaction among any given dyad in any given year, I divided the number of years Country X initiated against Country Y by the total number of annual observations between the two countries. I then calculated the conditional probability of reciprocal interaction by computing the number of times Country X reciprocates against Country Y. The conditional probability of actor initiation was calculated by dividing the number of times Country X initiates against any other country more than once in a given year by the total number of initiations by Country X. To compute the conditional probability of target initiation, the number of times Country X was a target of any other country more than once during a given year by the total number of times Country X was targeted. To find the conditional probability of the actor reaction pattern, the number of times any Country

M initiates against Country X during a year in which Country X has initiated against Country Y is divided by the total number of initiations by Country X. The conditional probability of target reaction is found by dividing the number of years in which Country Y initiates against Country M by the number of times in which Country Y is targeted by Country X in the same years. To calculate the conditional probability of remote reaction, I identified all of the years of dyadic interactions. For each dyad, I counted the total amount of initiations. I then counted the number of interactions between Country M and Country N during the same years of initiation. So, for example, if Country X initiated 6 times against Country Y in 1982 and 1996, and Country M initiated against Country S 1 time in 1982 and 2 times in 1996, the conditional probability for remote reaction would be (1+2=3)/6 = .5. So, the conditional probability of remote reaction for Country X → Country Y is .5.

After calculating all seven patterns of interaction, I used a difference of means test to assess the hypothesis. I calculated the means and variances for all seven patterns and plugged those numbers into this formula:

$$t = \frac{(\bar{y}_1 - \bar{y}_2)}{\sqrt{\frac{\sigma_1^2}{N_1 - 1} + \frac{\sigma_2^2}{N_2 - 1}}}$$

The $\bar{y}_1$ term represents the mean for the unconditional probability pattern. The $\bar{y}_2$ term represents the mean for each conditional probability pattern. The σ_1^2 term stands for the variance of the unconditional probability pattern, and the σ_2^2 term represents the variance for each conditional probability pattern. The N_1 term stands for the sample size of the

unconditional probability pattern, and the N_2 term stands for the sample size of each conditional probability pattern. The sample size varied for each, ranging from 11 (actor initiation, target initiation, and actor reaction) to 110 (reciprocal interaction).

Once the t score was calculated comparing unconditional probability with each of the other six patterns, I used a table of critical values of t distribution (Johnson, et al., 2001: 459) to determine whether or not statistically significant differences exist between these patterns. I also used the mean probabilities of each pattern in the following formula:

$$t = \frac{p}{\sigma}$$

The p term represents the mean of each conditional probability pattern, and the σ term represents the standard deviation of each pattern.

The results from this test were compared against a table of critical values of t distribution (Johnson, et al., 2001: 459) to find if any of the individual patterns are statistically significant.

Results

Now, I will discuss the results of this study and their relation to our general hypothesis. We will start by examining the basic unconditional probabilities and then compare them with data concerning the conditional probability patterns of international events. Then, I will discuss the results of my analysis of the data and its implications.

First, it is important to understand the unconditional probability of interaction among all possible directed dyads before we are able to compare and analyze the

conditional probabilities. Table 2 gives us a general idea of the international conflicts that occurred among the states in this study from 1979 to 2001. The second column of this table lists the number of times each state was involved in a conflict as the actor initiator, and the third column lists the number of times each state was involved in a conflict as the targeted state. The fourth column compares these two numbers in a ratio for each state.

Three interesting observations can be made from this table. First, the United States, Iran, Iraq, and Egypt all have ratios over 1. This is slightly misleading, however, because Egypt initiated conflict 3 times over a 22-year period, while Iran initiated conflict 22 times over the same period of time. It is also worth noticing that Iraq was targeted 21 times by other states, which is by far the most of any country in this study. This could be attributed, in part, to the Gulf War and the weapons inspections that took place in the 1990s, because 17 out of the 21 conflicts targeting Iraq took place from 1991 to 2000. The United States targeted Iraq 6 times during that time period, and Kuwait targeted Iraq 4 times. Egypt and Israel also each targeted Iraq for a total of 4 times, but Iran targeted Iraq 7 times (the most of any other state). Since Iran targeted Iraq sporadically throughout the entire observed time period, it seems that Iran is always targeting Iraq for one reason or another, but, unlike the other states (United States, Kuwait, etc.), Iran's actions are most likely not categorically related to the Gulf War and the weapons inspections in the 1990s. Also, it seems interesting that states that attempt to stay out of international armed conflict end up being picked on by other states in the region; neither Jordan nor Saudi Arabia initiated conflict during this 22-year span, yet they were both targeted by neighboring countries on several occasions.

In contrast to Table 2, Table 3 provides a bit more of an in-depth look at the dyadic interaction patterns found within the data. Here again, there are a few especially interesting observations worth noting. Iranian leadership, especially recently, has made no secret of its ill-will and hatred towards Israel. However, Iran, while being one of the most active initiators in the study, did not target Israel once from 1979 to 2001. It should also be observed that Iran, Syria, and Israel are the top three countries in terms of how many states they targeted during the specified time period. Accordingly, there are nine Middle Eastern countries in this study. Out of those nine, five countries are fairly peaceful. The remaining four, Iran, Iraq, Syria, and Israel, tend to cause the most trouble in the region. The United States is friendly with only one of those four states: Israel. In contrast, the United States is certainly not on good terms with Iran and Syria, and is in the middle of a war in Iraq. The American public, in general, is not aware of much of the world's sentiment about the American-Israeli relationship (Mearsheimer and Walt, 2006). For many Americans, it might be difficult to understand where this sentiment stems from, but the information in Table 3 presents an idea of why many foreigners, especially Middle Easterners, might question the seemingly biased relationship the United States has with Israel in contrast to Iran, Iraq, and Syria.

Table 4 lists the mean rank and *t* score of unconditional probability and each conditional probability by pattern. This table illustrates a main idea of conditional probability analysis that by having knowledge about the types of conditions that cause dyadic interactions, we can effectively predict future interactions. One very basic observation is that the mean unconditional probability is significantly less than even the lowest mean of any conditional probability interaction pattern. So, it is clear that any type

of conditional probability can provide more information about future events than unconditional probability. The remote reaction pattern has the largest mean probability of any pattern, and the *t* test indicates that remote reaction is an accurate representation of the population as a whole. So, out of any conditional probability, the remote reaction pattern could most usefully be applied to future political events in any dyad or system. It is important to understand that this significant finding is not merely coincidence. When other states see a conflict occur in their region, they are much more likely to engage in a conflict of their own than to anxiously await the results of the ongoing conflict to see what the implications for the region will be. In other words, states see conflict as an opportunity to make changes to the status quo through force of arms.

Table 5 contains the results from the difference of means test, which compared unconditional probability against each of the other six interaction patterns. This analysis is consistent with the mean ranking of Table 4 and with the hypothesis. In all but one instance, the conditional probability tests are statistically significant when stacked against the unconditional probabilities. Target initiation, target reaction, and remote reaction ranked highest on Table 4, and Table 5 shows that they are statistically significant compared to the unconditional probability. Overall, I think that Table 5 supports the central hypothesis of this project, which was that conflict in a region only causes more conflict because of the interdependence present in any given system, and that the conditional probability analysis of Middle Eastern conflict data, when compared with an unconditional probability analysis of the same data, may prove to be superior in making reliable predictions about future conflict in the Middle East and around the world.

Obviously, unconditional probability analysis is not enough when attempting to predict international political events.

The apparent statistical significance of the data suggests that using conditional probability as a method of analysis appears to provide implications for future events in the Middle East and could even be applied to the overall international system.

Conclusion

In the field of political science and international relations, the past thirty years has seen a surge of interest in the idea of using some type of scientific method to predict future political events. One of the theories that arose out of this field of study is the use conditional probability as a method analysis. Used in this study, conditional probability analysis offers us a way to systematically analyze events data and apply it to the international system. More specifically, in this study, we wanted to find out two things: First, we wanted to evaluate how significantly dyadic interactions affect the probability of the occurrence of subsequent interactions within that system. Second, we wanted to examine the possible implications of conditional probability analysis in terms of predicting future political events in the Middle East.

Based on the results of the study, it is fair to conclude that dyadic interactions in a region have a high probability of causing another type of interaction within the same region. However, conditional probability breaks down the framework of international events in such a way that gives us a more consistent and accurate means of political

forecasting. The tables show that conditional probability analysis can be used as a reliable mechanism for predicting future political events.

Within the Middle Eastern region, using the conditional probability method of analysis can have significant implications and effects. Let us take a look at a few scenarios that have developed since 2001 (the last year of data collected for this study). In 2003, the United States invaded Iraq. Could this event have been predicted by the results of our study? By simply looking at Table 3, which lists the unconditional probabilities for every dyad, it is interesting to note that the probability of the U.S. targeting Iraq is .2609 compared to a significantly smaller probability of Iraq targeting the U.S. of .087. This information alone is not very valuable, so let us analyze this conflict using the corresponding conditional probability pattern, actor initiation.

Soon after the September 11 attacks, the United States invaded Afghanistan because of its suspected relationship with Osama Bin-Laden and Al-Qaeda. Fairly soon after that, the United States began preparations to invade Iraq, also because of its suspected terrorist ties. Before the actual invasion of Iraq, one of the arguments for war espoused by the White House was that Saddam Hussein had strong connections to Al-Qaeda, and had, in effect, supported the September 11 terrorist attacks in New York City. One of the more official reasons for war was Hussein's continued violations of United Nations deadlines and sanctions. So, in this scenario, September 11 prompted the United States to engage in an actor initiation pattern. This pattern is characterized by Country X (U.S.) targeting Country Y (Afghanistan) and Country X (U.S.) also targeting Country M (Iraq). It is important to note that when compared to unconditional probability using a difference of means test, the actor initiation pattern proved to be statistically stronger.

Given the strength of the actor initiation pattern compared to unconditional probability, compounded with the statistical strength of the actor initiation pattern itself, I think that once the United States invaded Afghanistan, it was very apparent that Iraq was next.

Another serious conflict that arose in the Middle East after 2001 was the Hezbollah – Israeli conflict of 2006. In this instance, given the parties involved, I am relaxing the assumptions about states as the only relevant actors and allowing terrorist groups to be considered actors. This conflict falls under the target initiation pattern. Members of the Hamas organization first targeted Israel in the Gaza strip, and soon after that, members of Hezbollah targeted Israel on the Lebanese border. I think this can be attributed to many factors. First of all, from 1979 to 2001, Lebanon targeted only one other state: Israel. So, while Lebanon did not technically target Israel in this case, it is easy to see why a terrorist organization might be able to operate within its borders against Israel. Second, in contrast, Iran has not targeted Israel once from 1979 to 2001, despite its many threats to do so and its overt hatred of Israel. So, since Hezbollah is something of an Iranian state-sponsored terrorist organization, it seems that this would be an outlet for Iran to target Israel without officially doing so. Third, part of our basic hypothesis is that conflict in a region simply causes more conflict. This seems to be especially true in a situation like Israel's, because they have been a victim of target initiation several times throughout their short history. The difference between the target initiation pattern and unconditional probability, and the statistical significance of the pattern itself is enough to suggest that when Hamas targeted Israel, Hezbollah's attack could have been predicted fairly accurately using the target initiation pattern.

While the Iranians have not been involved in any conflict, technically, since 2001, they have no doubt become a major player in the region, particularly since the American invasion of Iraq. They have made blatant threats toward the United States and Israel, while continuing to ignore the United Nations and the rest of the world by actively seeking and building nuclear capabilities, as well as vehemently speaking out against the Western involvement in the Middle East. What does our conditional probability analysis suggest about future conflicts involving Iran?

As the political situation in Iraq continues to deteriorate, it seems that there is a high probability for Iran to target Iraq in some way. Simply looking at the unconditional probability of Iran initiating against Iraq supports this idea; the unconditional probability is .3044, which is the highest probability in any dyadic interaction in which Iran is the initiator. Even more convincing, the target initiation pattern suggests that this is the case. The United States (Country X) initiated against Iraq (Country Y), which implies that the probability of Iran (Country M) also targeting Iraq is very high. In fact, the values in Table 4 show that the target initiation pattern has the second highest mean conditional probability rank of any other pattern we observed. Also, the results of the difference of means test found in Table 5 show that especially when compared to unconditional probability, the target initiation pattern is a very reliable method of political forecasting. Based on these conclusions, it is very likely that Iran may initiate some type of conflict in the region very soon. Iraq seems like a very attractive target for Iran because of its current instability and its close proximity to Iran. I do not think Iran will engage in a full-scale war against Iraq, but I do think there is a high probability for minor conflicts to occur initiated by Iran against Iraq in the very near future.

However, it is interesting to note that despite its threats towards the United States and Israel, I do not think that Iran itself will initiate against either of these states anytime soon. Instead, I think it is very likely that Israel will be targeted in the near future by a state-sponsored terrorist organization associated with Iran. Iran is in a powerful position in the Middle East right now. First, they know that any type of state-sponsored terrorist organization with which they are involved can get away with almost anything. So, why would Iran risk their own stability and safety to officially launch an attack against Israel when they do not have to? Second, the Iranians know that the United States would be one of the only states to rush to Israel's defense in the event of an attack by a terrorist organization, and the U.S. is not in a political position to be able to go after any other states that they believe are sponsoring terrorism. Finally, the Islamic community will simply not turn against their Muslim brothers in Iran to defend Israel. So, I think that it is unlikely that we will see an official Iranian attack against Israel. However, I do think that it is extremely probable that we will see an Iranian state-sponsored terrorist organization attack Israel in the relatively near future.

In order for conditional probability analysis to be useful as a reliable method of political forecasting in the Middle East, terrorist organizations will have to be included in conflict data in some way. All three Middle Eastern scenarios discussed in this paper involve state-sponsored terrorism of some type. Unfortunately, terrorism is the "way of the world" in the Middle East right now. If they are included, conditional probability could be a vital tool in predicting international conflicts in the Middle East.

It is evident from this study that dyadic interactions strongly affect the probability of subsequent dyadic interactions. Dyadic interactions almost guarantee another dyadic

interaction of some type. This knowledge can be extremely useful in predicting future political events and conflicts. This method of analysis should become especially important in international conflicts, because it could easily be adapted and applied to any system in the world. Conditional probability seems to be a useful technique that could be commonly used by anyone interested in predicting international conflict.

References

Bueno de Mesquita, Bruce (1984). Forecasting policy decisions: An expected utility approach to post-Khomeini Iran. *Political Science, 17*, 226-236.

Bueno de Mesquita, Bruce (1996). The Benefits of a Social Scientific Approach to Studying International Affairs. In Ngaire Woods, (Ed.), *Explaining International Relations Since 1945.* Oxford: Oxford University Press, 49-75.

Bueno de Mesquita, Bruce. 1998. "The End of the Cold War: Predicting an Emergent Property." *The Journal of Conflict Resolution* 42 (2), 131-155.

Gaddis, John Lewis (1992-1993). International Relations Theory and the End of the Cold War. *International Security*, 17 (3), 5-58.

Gaddis, John Lewis (1996). On Moral Equivalency and Cold War History. *Ethics and International Affairs 10.*

Ghosn, F., Palmer, G., & Bremer, S. (2004). The MID3 Data Set, 1003-2001: Procedures, Coding Rules, and Description. *Conflict Management and Peace Science 21*, 133-154.

Ghosn, F., & Bennett, S. (2003). Codebook for the Dyadic Militarized Interstate Incident Data, Version 3.0. Online: http://cow2.la.psu.edu.

Johnson, J., Joslyn, R., & Reynolds, H. (2001). Political Science Research Methods. Washington, DC: Congressional Quarterly, Inc.

Lakotos, I. *Criticism and the Growth of Knowledge* (pp. 91-195) New York: Cambridge University Press.

Leng, Russell J. (2000). Crisis Behavior and War. In John Vasquez (Ed.), *What Do We Know About War?* (pp. 235-258) Lanham, MD: Rowman & Littlefield Publishers, Inc.

Mearsheimer, J., and Walt, S. (2006). The Israel Lobby. *London Review of Books*, 28 (6).

Mintz, A., and Schrodt, P. (1987). Distributional Patterns of Regional Interactions: A Test of the Poisson as a null model. In Claudio Cioffi-Revilla, Richard L. Merritt, and Dina A. Zinnes, (Eds.), *Interaction and Communication in the Global Arena.* Beverly Hills: Sage.

Moaz, Zeev. (2000). The Street Gangs of World Politics – Their Origins, Management, and Consequences, 1816 – 1986. In John Vasquez (Ed)., *What Do We Know*

About War? (pp. 111-144) Lanham, MD: Rowman & Littlefield Publishers, Inc.

Ray, J., & Russett, B. (1996).The future as arbiter of theoretical controversies: Predictions, explanations and the end of the Cold War. *British Journal of Political Science*, *26*, 441-470.

Richardson Arms Race Model (2002). Retrieved May 26, 2007, from http://shakti-trincoll.edu/~pbrown/armsrace.html.

Schrodt, P., & Mintz, A. (1988). The conditional probability analysis of international events data. *American Journal of Political Science, 32,* 217-230.

Vasquez, John A. (Ed.). (2000). *What do we know about war?*. Lanham, MD: Rowman & Littlefield Publishers, Inc.

Wayman, Frank W. (2000). Recurrent Disputes and Explaining War. In John Vasquez (Ed.), *What Do We Know About War?* (pp. 219-234) Lanham, MD: Rowman & Littlefield Publishers, Inc.

Table 1

Dyadic Interaction Patterns

Type	Example
Reciprocal	X → Y => Y → X
Actor Initiation	X → Y => X → M
Target Initiation	X → Y => M → Y
Actor Reaction	X → Y => M → X
Target Reaction	X → Y => Y → M
Remote Reaction	X → Y => M → N

Table 2

MIDS Events 1979 – 2001 by Nation

Nation	As Actor Initiator	As Target	Ratio
US	17	14	1.21
USSR/Russia	11	7	1.57
Iran	22	13	1.69
Iraq	11	21	.52
Egypt	3	1	3
Syria	10	0	0
Lebanon	1	2	.5
Jordan	0	3	0
Israel	6	8	.75
Saudi Arabia	0	5	0
Kuwait	4	11	.36

Table 3

Yearly Probabilities of Interactions by Dyads

Dyad	Unconditional Probability
US, USSR/Russia	.2609
US, Iran	.2174
US, Iraq	.2609
US, Egypt	0
US, Syria	0
US, Lebanon	0
US, Jordan	0
US, Israel	0
US, Saudi Arabia	0
US, Kuwait	0
USSR/Russia, US	.3044
USSR/Russia, Iran	.1739
USSR/Russia, Iraq	0
USSR/Russia, Egypt	0
USSR/Russia, Syria	0
USSR/Russia, Lebanon	0
USSR/Russia, Jordan	0
USSR/Russia, Israel	0
USSR/Russia, Saudi Arabia	0
USSR/Russia, Kuwait	0
Iran, US	.1739
Iran, USSR/Russia	.0435
Iran, Iraq	.3044
Iran, Egypt	0
Iran, Syria	0
Iran, Lebanon	0
Iran, Jordan	0
Iran, Israel	0
Iran, Saudi Arabia	.1739
Iran, Kuwait	.2609
Iraq, US	.087
Iraq, USSR/Russia	0
Iraq, Iran	.1304
Iraq, Egypt	0
Iraq, Syria	0
Iraq, Lebanon	0

Table 3 (continued)

Yearly Probabilities of Interactions by Dyads

Iraq, Jordan	0
Iraq, Israel	.0435
Iraq, Saudi Arabia	0
Iraq, Kuwait	.2174
Egypt, US	0
Egypt, USSR/Russia	0
Egypt, Iran	.0435
Egypt, Iraq	0
Egypt, Syria	0
Egypt, Lebanon	0
Egypt, Jordan	0
Egypt, Israel	.087
Egypt, Saudi Arabia	0
Egypt, Kuwait	0
Syria, US	.0435
Syria, USSR/Russia	0
Syria, Iran	0
Syria, Iraq	.087
Syria, Egypt	0
Syria, Lebanon	.0435
Syria, Jordan	.087
Syria, Israel	.1739
Syria, Saudi Arabia	0
Syria, Kuwait	0
Lebanon, US	0
Lebanon, USSR/Russia	0
Lebanon, Iran	0
Lebanon, Iraq	0
Lebanon, Egypt	0
Lebanon, Syria	0
Lebanon, Jordan	0
Lebanon, Israel	.0435
Lebanon, Saudi Arabia	0
Lebanon, Kuwait	0
Jordan, US	0
Jordan, USSR/Russia	0

Table 3 (continued)

Yearly Probabilities of Interactions by Dyads

Jordan, Iran	0
Jordan, Iraq	0
Jordan, Egypt	0
Jordan, Syria	0
Jordan, Lebanon	0
Jordan, Israel	0
Jordan, Saudi Arabia	0
Jordan, Kuwait	0
Israel, US	0
Israel, USSR/Russia	0
Israel, Iran	0
Israel, Iraq	.087
Israel, Egypt	.0435
Israel, Syria	0
Israel, Lebanon	.0435
Israel, Jordan	.0435
Israel, Saudi Arabia	.0435
Israel, Kuwait	0
Saudi Arabia, US	0
Saudi Arabia, USSR/Russia	0
Saudi Arabia, Iran	0
Saudi Arabia, Iraq	0
Saudi Arabia, Egypt	0
Saudi Arabia, Syria	0
Saudi Arabia, Lebanon	0
Saudi Arabia, Jordan	0
Saudi Arabia, Israel	0
Saudi Arabia, Kuwait	0
Kuwait, US	0
Kuwait, USSR/Russia	0
Kuwait, Iran	0
Kuwait, Iraq	.1739
Kuwait, Egypt	0
Kuwait, Syria	0
Kuwait, Lebanon	0
Kuwait, Jordan	0
Kuwait, Israel	0
Kuwait, Saudi Arabia	0

Table 4

Mean Rank of Conditional Probability by Pattern

Pattern	Mean	T score
Unconditional Probability	.033955	.46418
Reciprocal Interaction	.162489	.419051
Actor Initiation	.187668	.930464
Target Initiation	.470418	1.52003
Actor Reaction	.158645	.806813
Target Reaction	.34127	.868917
Remote Reaction	.907556	3.77784*[3]

[3] Significant at the p<.05 level; two-tailed test

Table 5

Difference of Means Test

Pattern	Difference in Means	T score
Unconditional Probability, Reciprocal Interaction	.128534	-3.33675*
Unconditional Probability, Actor Initiation	.153713	-2.39547*
Unconditional Probability, Target Initiation	.43643	-4.44832*
Unconditional Probability, Actor Reaction	.12469	-1.99257
Unconditional Probability, Target Reaction	.307315	-4.04828*
Unconditional Probability, Remote Reaction	.873601	-18.339*