# MACHINE CODING OF EVENT DATA
# USING REGIONAL AND INTERNATIONAL SOURCES

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**ABSTRACT**

This article discusses research on the machine coding of international event data from international and regional news sources using the Kansas Event Data System (KEDS). First, we suggest that the definition of an "event" should be modified so that events are explicitly and unambiguously defined in terms of natural language. Second, we discuss KEDS: a Macintosh-based machine coding system using pattern recognition and simple linguistic parsing to code events using the WEIS event categories. Third, we compare the Reuters international news service reports with those of two specialized regional sources: the foreign policy chronologies in the *Journal of Palestine Studies* and the German language biweekly publication *Informationen*.

We conclude by noting that machine coding, when combined with the numerous sources of machine readable text that have become available in the past decade, has the potential to provide a much richer source of event data on international political interactions than that currently available. The ease of machine coding should encourage the creation of event coding schemes developed to address specific theoretical concerns; the increased density of these new data sets may allow the study of problems that could not be analyzed before.

**INTRODUCTION**

This article focuses on three topics related to current developments in event data.  First, we argue that the definition of an event should be modified to minimize coding ambiguities and that the concept of an "event" should be linked to the actual phenomenon observed by most political scientists:  natural language reports.  Second, we briefly describe a machine coding system we have developed and compare machine and human coding of events.  Third, we discuss the results of coding two regional sources, the chronologies of the *Journal of Palestine Studies* and the German Foreign Ministry's *Informationen*, with the Reuters news service, a comprehensive international source.

Event data — nominal or ordinal codes recording the interactions between international actors as reported in the open press — are one of the most common types of information used in quantitative international relations research.  Event data break down complex political activities into a sequence of basic building blocks (e.g., comments, visits, grants, rewards, protests, demands, threats, military engagements) that a researcher can aggregate into summary measures of foreign policy exchanges.  While event data cannot tell us everything important about foreign policy — for example, they reveal nothing about the *process* of foreign policy decision-making — they do provide a convenient window onto discrete actions and communications directed from one actor to another over time.[1]

Charles McClelland originally developed this concept in the early 1960s as a bridge between the traditional approach of diplomatic history and the new quantitative analysis of international politics.[2]  McClelland reasoned that history could be decomposed into a sequence of discrete events.  A data set consisting of a large number of such events could then be studied systematically using statistical techniques.  Event data formed a link between the then-prevalent general systems theories of international behavior and the textual histories that provided an empirical basis for understanding that behavior.

> International conduct, expressed in terms of event data, is the chief dependent variable of international relations research.  . . .  It is interesting that a starting point is provided as readily by the ordering principle of classical diplomatic history as by the basic concepts of general system analysis.  Thus, we may assert that the prime intellectual task in the study of international relations is to account for actions and responses of states in international politics by relating these to the purposes of statecraft . . . tracing recurring processes within these components, [and] noting systematically the structure and processes of exchange among the components. (McClelland, 1970:6)

Event data are available in an assortment of forms and coding schemes.  The event data sets most frequently used for international relations research are Azar's (1982) Conflict and Peace Data Bank (COPDAB) and McClelland's (1976) World Events Interaction Survey (WEIS).  Both data sets attempt to code all international interactions by all states and some non-state actors (such as the United Nations and national liberation movements) that are reported in specific sources.[3]  The

COPDAB data collection, available from the Inter-University Consortium for Political and Social Science Research (ICPSR), covers the period between 1948 and 1978.[4]  A WEIS data set for 1966-1991 exists; however, the WEIS set at the ICPSR covers only 1966 through 1978.

In contrast to the general COPDAB and WEIS collections, specialized event data sets such as Hermann, East, Hermann, Salmore, and Salmore's (1973) Comparative Research on the Events of Nations (CREON) and Leng's (1987) Behavioral Correlates of War (BCOW) monitor specific subsets of behavior:  foreign policy and crises respectively.  A variety of domestic and international event data, usually focusing on a limited set of actions (e.g., uses of force, domestic violence, or changes of government), are embedded in other collections such as Rummel's (1972) Dimensionality of Nations (DON), the *World Handbook* (Taylor and Jodice, 1983), and various Gurr data sets (e.g., Gurr, 1974).  Finally, there are several event data sets that focus on a subset of countries, such as southern Africa, or a specific crisis, such as Pearl Harbor.[5]

Private political consulting firms such as CACI, Inc.-Federal (1979) and Third Point Systems (Howell, Groves, Morita, and Mullen, 1986) have also collected event data, as have U.S. governmental agencies such as the Department of Defense and various intelligence agencies (see Daly and Andriole, 1980; Andriole and Hopple, 1984; and Hopple, Andriole, and Freedy, 1984). The United States Defense Advanced Research Project Agency (DARPA) sponsored a large-scale project in the 1970s to develop event data models for crisis forecasting and management.  In the early years of the Reagan administration, the National Security Council undertook a major event data collection and analysis effort; however, the NSC discontinued this project in 1984.[6]  Significant Department of Defense support for event data collection ended in the mid-1980s, although a number of informal efforts maintaining event data sets have continued.  Unfortunately, these data sets, along with many of the collections developed by consulting firms for the U.S. government, remain "fugitive;" they are informally shared within the quantitative IR community but are not available in public data archives such as the ICPSR.[7]

In our view, this decline in the collection and availability of event data is unfortunate.  Political science researchers use event data sets extensively.  McGowan, Starr, Hower, Merritt, and Zinnes (1988) note that the total citations to the CREON, WEIS, and COPDAB event data sets are comparable in number to the *World Handbook*, itself second only to the Correlates of War data set.[8] Those event data sets plus the event data portions of the *World Handbook* and the Gurr data sets also account for 41% of all institutional requests for international relations data sets from the ICPSR (McGowan et al., 1988:111).  Thus, it is essential to find ways to maintain and extend these data sets.

## DEFINING AN "EVENT"

Despite the widespread use of event data, there is no single universally accepted definition of what constitutes an "event," a lacuna that has done little to enhance the credibility of the approach. This section will first survey some existing definitions, then propose an alternative.

The early event data projects provided relatively succinct definitions. According to Burgess and Lawton (1976:6), for example, "events data is the term that has been coined to refer to words and deeds — i.e. verbal and physical actions and reactions — that international actors (such as states, national elites, intergovernmental organizations and NGOs) direct toward their domestic or external environments." Azar and Ben-Dak define an event as:

> some activity undertaken by an international actor (a nation-state, a major subunit of a nation-state, an international organization) . . . at a specific time and which is directed toward another actor for the purposes of conveying interest (even non-interest) in some issue. Thus an event involves (1) an *actor*, (2) a *target*, (3) a *time* period, (4) an *activity*, and (5) an *issue* about which the activity revolves. (1975:1; quoted in Laurance, 1990:112)

The COPDAB project designates events as:

> occurrences between nations which are distinct enough from the constant flow of "transactions" (trade, mail flow, travel and so on) to stand out against this background as "reportable" or "newsworthy." Thus, to qualify as an "event," an occurrence has to be actually reported in some reputable and available public source. (Azar, 1980:146; see also Davies, 1991:3)

The WEIS codebook does not contain a clear description of an event, but an early paper by McClelland provides the following definition:

> Event-interaction is meant to refer to something very discrete and simple — to the veritable building blocks of international politics, according to my conception. The content of diplomatic history is made up, in large measure, of event-interactions. They are the specific elements of streams of exchange between nations. Here are a few examples for hypothetical Nations A and B: Nation A proposes a trade negotiation, Nation B rejects the proposal, Nation A accuses B of hostile intentions, Nation B denies the accusation, Nation B deploys troops along a disputed boundary, Nation A requests that the troops be withdrawn, . . . Each act undertaken by each actor as in the illustration is regarded as an event-interaction. (1967:8)

In a similar fashion, the manual for the BCOW data set (Leng, 1987) does not provide an explicit definition of an event but its dense set of verb-oriented event categories implicitly describes the concept.[9]

There are at least two significant problems with these older definitions from the standpoint of rigorously delineating event data. First, they refer to activities of international actors that an analyst or coder almost never observes. An analyst observes the *report* of an activity. This difference may seem subtle but it is important; it is the same as the difference between an attitude or opinion — unobservable mental states — and the answer to a questionnaire, which is observable.

Second, none of the definitions explicitly indicates what constitutes an "activity," "transaction," or "action." In some cases (e.g., BCOW), the codebook covers this quite thoroughly. But in other

instances — most importantly, the ICPSR's COPDAB and WEIS codebooks — the coder is given only a set of English verbs, verb phrases, and noun phrases from which to infer the underlying coding rules.  Through the use of the phrase "direct towards," some definitions (Burgess and Lawton, 1972; Azar and Ben-Dak, 1975) also implicitly require an assessment of motive on the part of the initiator of the event.  This leaves considerable room for ambiguity in interpretation.  Lest this seem like a trivial point, one major source of ambiguity in event coding arises from policy statements with no explicit target audience, e.g., "Iraq announced it was raising its oil output beyond OPEC quota levels."  Some coding systems do not consider this an event because of the absence of a target; others consider it an event with "the world" as the target.

### An Alternative Definition

At the risk of definition proliferation, we suggest the following formal definition of an event:

> An *event* is an interaction, associated with a specific point in time, that can be described in a natural language sentence that has as its subject and object an element of a set of *actors* and as its verb an element of a set of *actions*, the contents of which are transitive verbs.[10]

When applied to a specific data source, replace the words "can be" with "is."  This definition encompasses most of what is currently considered to be event data but, unlike the existing definitions, it can be unambiguously implemented.  The key elements are:  natural language, actors, actions, and time.

*Natural language*.  Event data coders do not observe events; they observe reports of events presented in a natural language such as Arabic, Chinese, English, German, or Hindi.  Empirically, events can only be defined with respect to a human language or set of languages.  The event coding exercise converts natural language into nominal data that can be analyzed using formal methods.[11]

*Actors*.  Any model of political activity will be specific to certain persons, organizations, and places, all of which are specified by noun phrases in the language or languages used in the source.  Many of these phrases may be synonyms referring to the same actor.  For example,  in U.S. political discourse, the former Union of Soviet Socialist Republics might variously be called *the USSR*, *the Soviets*, *the Soviet Union*, or by the name of its current leader (e.g., *Khrushchev*, *Brezhnev*).  For most international relations research, the actors will be political entities; however, the definition is flexible and allows for the possibility of human-nature interactions if this is important for the research questions being studied.

*Actions*.  An event coding scheme deals only with certain interactions between actors.  All of these interactions can be described by transitive verbs; for example, *apologize*, *met with*, *endorsed*, *promise*, *accuse*, *threaten*, or *attack*.[12]  As with the nouns, multiple verbs might signify the same category of behavior, either because the words are synonyms within the language (e.g., *grant, bestow*, *contribute*, *donate*, *fund*, *present*, *provide*) or because the behaviors, although linguistically distinct, are politically equivalent, a characteristic that Most and Starr (1989: chapter 5) refer to as

"foreign policy substitutability."  These equivalence sets will vary with the specific problem or the theoretical approach and in large part determine the validity of a particular coding scheme.

*Time*.  All event data record a time or period of time when an interaction occurred.  The most common unit used is the day, although in some instances (for example, studying crisis negotiation) a finer unit such as the hour might be appropriate.  Most analyses of event data aggregate to either months or years.

## Additional Issues

This proposed definition does not address all possible sources of ambiguity in event data and it deals only with the most basic

### <date> <source> <action> <target>

part of event data, ignoring the additional complex codes that are assigned in a system such as GEDS or BCOW.[13]  Event data defined in this fashion are relatively straightforward to code by machine, however, and the coding is completely reproducible.  Machine coding requires only the appropriate actor and action lists and a parser for the relevant languages of sufficient complexity to identify subjects, verbs, direct objects, and indirect objects.

One objection that might be raised to the approach of focusing on a standard list of verbs and actors is that in some unusual situations, the exact wording of an official speech will be an important point in negotiations.  For example, President Richard Nixon's use of the term "People's Republic of China" rather than "Red China" signaled the beginning of the USA-PRC détente in 1970.  Similarly, the United States  insisted on some very precise wording in the statements by Yasir Arafat in 1988 prior to the re-establishment of U.S. diplomatic contact with the PLO.  However, as illustrated in Table 1, even a negotiation involving specific language generates a large number of standard event verbs such as *accept, reject, inform*, *confer*, and *rebuke*.  Precise language may be the *object* of a negotiation, but rarely is it part of the *process* of negotiation, and even less does it affect the *reporting* of the political behavior.

## Table 1
### Reuters Leads Dealing with PLO Recognition of Israel,  December 1988

| | |
|---|---|
| 7 Dec 88 | Yasser Arafat said on Wednesday the Palestine Liberation Organisation accepted the existence of Israel and renounced the use of terrorism. |
| 8 Dec 88 | Rival Israeli leaders Shimon Peres and Yitzhak Shamir rejected PLO chairman Yasser Arafat's acceptance of Israel as a bid to destroy the Jewish state and a publicity stunt. |
| 12 Dec 88 |  PLO Chairman Yasser Arafat will recognize Israel within its pre-1967 borders in his address to the United Nations in Geneva, Arafat's political adviser Bassam Abu Sharif said in an interview. |
| 13 Dec 88 | Yasser Arafat asked Israel on Tuesday to come to Geneva to work together for peace in the Middle East but the United States said he had not clearly met its conditions for |

a dialogue.

13 Dec 88    Jordan's King Hussein rejected on Tuesday a U.S. statement saying the PLO had not fulfilled all the conditions Washington had demanded to clear the way for a peace dialogue.

13 Dec 88    Washington has informed Israel that the U.S. will recognize the Palestine Liberation Organization if Yasser Arafat meets its terms in a speech to the U.N. General Assembly on Tuesday.

13 Dec 88     The United States and the Palestine Liberation Organization conferred in an effort to ensure Yasser Arafat's U.N. speech met Washington's terms for recognizing the PLO, Israeli officials said.

14 Dec 88    Egyptian President Hosni Mubarak rebuked U.S. Secretary of State George Shultz over his policy towards the Palestinians in a rare, 15-minute telephone call on Wednesday.

14 Dec 88    The United States decided on Wednesday to open direct talks with the PLO, saying it has met the conditions for beginning a dialogue on Middle East peace.

14 Dec 88    Egypt on Thursday welcomed President Reagan's decision to open talks with the PLO and said it would improve Washington's ties with the Arab world.

15 Dec 88    The speaker of the Palestinians' parliament-in-exile Thursday welcomed Washington's decision to hold talks with the Palestine Liberation Organization after years of refusing to do so.

15 Dec 88    The European Community on Friday welcomed the U.S. decision to open talks with the Palestine Liberation Organisation (PLO) and urged all parties involved to convene a peace conference.

16 Dec 88    American and Palestine Liberation Organisation (PLO) representatives open talks in Tunis on Friday in what could prove to be an historic turning-point in over 40 years of Middle East conflict.

This does not rule out the possibility of focusing on specific phrases that are used with specialized intent in diplomatic communication.  For example, the phrase "frank discussion," when used by the U.S. State Department, almost always means that the discussions involved substantial disagreement.  To the extent that these words are used consistently, they can be coded as signaling disagreement:  the phrase "had frank discussions" might code to a WEIS 111 (*Turn down proposal*) rather than a WEIS 025 (*Explain policy*), despite the latter interpretation being closer to the dictionary meaning of the phrase.

The language used to report events may vary dramatically between sources.  Pro-government and anti-government sources might report the same occurrence using quite different words:

Terrorists slaughtered innocent civilians in the town of Ochos Rios before being driven off by government troops.

Liberation forces battled occupying forces in the town of Ochos Rios, causing several casualties before retreating.

Rhetorical flourishes — *terrorists* versus *liberation forces*, *slaughtered* versus *causing*, *driven off* versus *retreated* — often say more about the source than they do about the political behavior.  In many cases, such rhetoric is used in a highly styled fashion that can actually improve coding accuracy, once the patterns are identified and vocabulary lists customized.  From either phrasing of this event one can infer that things were not very quiet in Ochos Rios and that people were killed. With multiple reports of this type, one can reasonably infer some sort of insurgency.

Similarly, the extensive popular literature on differences in U.S. and Japanese business negotiating styles (e.g., Hall and Hall, 1987) points out that Japanese negotiators rarely explicitly reject a proposal (e.g., "We will consider your proposal" means "No") whereas U.S. negotiators tend to use extremely strong language (e.g., "We can't possibly work with that" means "We're getting close to an agreement").  To the extent that such phrases are used consistently — and unless they are used consistently they have no information value under any circumstances — the phrases can be accommodated in a machine coding framework, although the lists of verbs may need to vary with the source of the statement.  Because those lists are explicit and reproducible, the source of errors due to misinterpretation can be isolated and identified.  In some cases, the terms used may be so ambiguous as to preclude coding altogether.  However, if the source itself is ambiguous, human coding will also be unreliable and the appropriate action is to find an alternative source of information.[14]

An open question in the event data literature is whether it is possible to do meaningful political analysis using discrete events that are unconnected by an underlying narrative structure.  Humans have a strong cognitive tendency to organize events into "stories" that follow a logical structure, but many of the existing applications of event data, particularly those using the methods of statistical time series (e.g., Goldstein and Freeman, 1990), have not done so.

We believe event data are valuable even when unaccompanied by narrative.  First, although humans organize events into narratives this does not necessarily mean that narratives are the best way to analyze events in all circumstances.  Narratives organize events, but the use of an inappropriate narrative structure may organize events incorrectly and with disastrous results:  these problems have been discussed extensively studied in the foreign policy literature.

Furthermore, event data can be used in narrative structures if a researcher chooses to use that approach.  Virtually all formal models of narratives involve basic subject-verb-object combinations at their core but, in contrast to statistical approaches, these models impose additional linkages between the events themselves and between events and other information.[15]  While most of the existing narrative models have been done with a substantial amount of human coding, a number of projects are underway that extract the relevant information directly from text (e.g., Alvarado, 1990; Sundheim, 1991).  Almost any process that translates a natural language text into a formal narrative structure such as a script (Schank and Abelson, 1977) will go through a process very similar to that involved

in event data coding because subject-verb-object combinations must be mapped unambiguously into the slots of the script. While the resulting data structures will be more complex than those found in statistical event data studies, the coding problems are almost identical.

### MACHINE CODING

Over the past several years, we have been working on the development of a machine coding system called KEDS (Kansas Events Data System).[16] This system is described in detail in Schrodt, Davis, and Weddle (1993); Schrodt (1993) discusses two precursors of KEDS. KEDS is a pattern-matching system with some linguistic capabilities.[17] KEDS's basic task is to identify the subject, verb, and object in a sentence describing an event, look up the appropriate codes, and write the resulting event record to a file. The subject and object determine the source and target respectively; the verb determines the event code.[18]

The coding is done using patterns in two files labeled *Actors* and *Verbs*. The *Actors* file is a list of political actors with their corresponding codes in brackets:

```
AMMAN [JOR]
AMNESTY_INTERNATIONAL [NGO]
ANDORA [AND]
ANGOLA [ANG]
ANKARA [TUR]
AQUINO [PHL]
```

Words connected by an underscore (_) must match completely; otherwise partial matches are allowed. For example, the pattern "ANGOLA" will match "Angola," "Angolan," and "Angola's." At present, the actor list contains approximately 350 separate items. This allows KEDS to handle virtually any event in the Middle East or Central Europe (our two test regions). The actor list can be easily expanded.

The *Verbs* file is organized around the primary verb but includes the possibility of exceptions that change the meaning of the verb depending on context:

```
ABSTAIN [111]
ACCEPT [081]
 - * CREDENTIALS  [064]
 - * FORMULATION  [042]
 - * INVITATION   [082]
 - DOES NOT *     [111]
 - + HAD * $      [081]
 - * CHARGES      [013]
ACCUSED [121]
 - + WERE * BY $ [121]
 - + WAS * BY $  [121]
```

In the first example, ABSTAIN is always coded 111, corresponding to the WEIS category "Turn down proposal; reject protest, demand, threat etc." ACCEPT is normally coded 081 ("Make

substantive agreement"), but has a variety of exceptions.  For example, ACCEPT CREDENTIALS is coded 064 ("Grant diplomatic recognition") and ACCEPT FORMULATION is coded 042 ("Endorse others' policy or position").  The exceptions are typically the direct object of the sentence when the target is found in the indirect object or as part of a compound subject.

Patterns can also be used to reverse the identification of source and target.  By default, KEDS assumes that the source is the first actor in the sentence and the target is either the first actor after the verb or, if there is no actor after the verb, the first actor before the verb.  In some circumstances, most notably the use of passive voice, these need to be reversed.  For example, in the statement "SYRIA WAS ACCUSED BY THE UNITED STATES," Syria is the target and the United States the source.  This is handled by the pattern "+ WAS * BY $ [121]":  The "+" indicates where the target is found and the "$" indicates where the source is found.

The *Verbs* patterns handle a variety of other contingencies.  Events can be paired so that a single verb generates two events with the source and target reversed; this is most commonly used to insure that a visit (WEIS 032) from X to Y also generates a hosting of Y by X (WEIS 033).  Events can be subordinate, so that a coding is used only if no alternative is found, or dominant, so that matching the pattern suppresses any further attempt to match other patterns.  Finally, patterns can indicate that the sentence as a whole does not contain an event; this is used to discard sporting reports of the "EGYPT BATTLED SPAIN IN WORLD CUP ACTION TODAY" genre.

The *Actors* and *Verbs* lists were constructed inductively, a process we called "training" the system.  The pattern lists were initialized with the verbs and nation-states mentioned in the ICPSR WEIS codebook and a list of nation-states.  Several thousand Reuters lead sentences were then coded using the system.  KEDS would attempt a coding; if the human coder agreed with the coding, he or she would go on to the next event.  If the coder disagreed with the coding, and the error was due to incomplete vocabulary, then the coder would enter the appropriate new actor, verb, or exception pattern.  Since the machine quickly learns to code routine events correctly, most of the coder's time is spent developing new vocabulary and interpreting complex sentences, a task somewhat less monotonous than conventional event coding.

The remaining capabilities of KEDS in English involve basic syntactic housekeeping:

1.  Eliminate the words "A", "AN" and "THE";
2.  Identify compound actors (e.g., "JORDAN AND SYRIA");
3.  Dereference pronouns (e.g.,in the phrase "JORDAN SAID IT OBJECTED . . . " the word "IT" is identified as referring to "JORDAN");
4.  Eliminate subordinate phrases delimited by commas;
5.  Eliminate any material delimited by "comment" brackets (e.g., /*…*/); these allow material in the text to be omitted from coding;

6. Identify compound verb phrases.

The syntactic analysis, in particular the dereferencing of pronouns, was done using simple rules rather than by completely parsing the sentence; these techniques have proven quite sufficient for the Reuters material.

KEDS is a fairly general platform for event coding, since all of the information relevant to a coding scheme resides in the *Actors* and *Verbs* files, rather than in the program itself. A new event coding scheme, for example one focusing on international economic interactions, could be implemented by changing the *Verbs* file without changing the *Actors* file; coding of internal actors could be implemented by changing the *Actors* file without changing the *Verbs*. All of the information required by the program is stored in ASCII files that can be edited using a word processor. When coding without human intervention, KEDS processes about 200 Reuters leads per minute using a Macintosh II. KEDS can also be used for machine-assisted coding, with the coder inserting new events, switching the order of source and target, and changing the event using menu options in the program, but not trying to change the program's vocabulary.

## Human Versus Machine Coding

There are a number of reasons to move from human coding to machine or machine-assisted coding of event data, including speed, flexibility, and lower cost. Traditionally, event data have been coded by teams of scholars, often supervising groups of students who may change from semester to semester. It is a slow, labor-intensive undertaking that requires a long-term investment of time and resources. Furthermore, it is almost impossible to make modifications in the coding rules or categories after they have been established since to do so would require that the data be completely recoded. In contrast, machine coding is quick (once the researcher has developed the vocabulary), inexpensive, and quite flexible. Machine or machine-assisted coding only makes sense, however, if it is roughly as reliable as human coding. Ideally, machine coding should be able to duplicate the codes that human coders would assign in those cases when human coding is correct and improve on human coding when the latter is flawed.

In our experience, human coding will differ from machine coding of the same text for one of three reasons:

1. The text from which the human is coding the event is too syntactically complex for the machine to code or is grammatically incomplete but unambiguous;

2. The human is using knowledge beyond that present in the sentence to determine the event code;

3. The human is not correctly applying the coding rules.

The first situation is the only one where human coding is unequivocally superior to machine coding; the extent to which this occurs depends entirely on the source text.  Humans are clearly better than machines at manipulating natural language, particularly if the text uses an unusual grammatical construction.

In the second situation, our assessment differs from that of many other event data coding projects in that we have deliberately removed the element of human "judgment" and knowledge of "context" in determining event codes.  Although coder judgment is intuitively appealing, the assumption that the contextual knowledge of human coders will automatically improve the quality of event data ignores virtually everything we know about human cognition and perception.  Humans, unlike machines, read text amid a background of biases, expectations, and prejudices.[19]  Thus, the "judgment" introduced by a human is as likely to increase the amount of noise in the data as it is to decrease it.[20]

For example, students are often astonished to find that China, considered a military "superpower," had a smaller military budget in the 1980s than Japan, a country students usually consider militarily insignificant.[21]  These preconceptions can cause problems even for experienced analysts.  Laurance reports an experiment where:

> in-house military analysts were used to help create a set of country scores for the military capability (naval in this case) of various LDCs.  When we validated these scores with a set of outside experts, most were surprised that the PRC had scored so high.  Upon reflection we realized that the high scores were a function of the expectation that they would be very capable, since at the time they were in the 'communist enemy' category.  In addition the PRC was high on the collection and analysis priorities list of the intelligence community.  More information existed on the PRC navy, compared to say Malaysia, Singapore and India. (1990:125)

In the third instance, machine coding is clearly superior to human coding.  Because event coding is a very tedious process and event coders are often poorly paid, poorly motivated, and have a difficult time focusing on the task for extended periods of time, the importance of this factor should not be underestimated.  Furthermore, any event data set contains a variety of unstated assumptions.  Careful training can reduce the coding variance between individuals at a specific time and under the supervision of a specific project director but cannot reduce the variance between the coding interpretations of separate projects.  A machine coding system, in contrast, eliminates intercoder variance entirely and provides explicit, preservable coding rules; the same patterns used in 1992 can be used in 2002.  Such reproducibility is vital to the development of replicable studies and is impossible with human coders.

As Weber (1990:17) notes, content analytic reliability consists of three components: stability (the ability of a coder to assign the same code to a text when coding it more than once), reproducibility (intercoder reliability), and accuracy (the ability of a group of coders to conform to a

standard).  For a given set of patterns, the stability of machine coding is 100% because the machine will always code the same text in the same fashion.  The 100% stability of machine coding may make that method preferable to human coding in some applications, particularly when a time series is being maintained for a number of years.

## Reliability and Validity

KEDS has been developed to code 3-digit WEIS categories, although we expect that it could also be used to assign COPDAB event codes.  Most of the English-language development was done by coding Reuters "lead" sentences on articles dealing with the Middle East:  Egypt, Israel, Jordan, Lebanon, the Palestinians, and Syria.  KEDS' level of accuracy — its degree of reliability — developed on a classical learning curve.  Using the basic verbs identified in the WEIS codebook (about 300 patterns), KEDS's coding of Reuters leads had an accuracy of around 50 percent. Development of approximately 800 additional patterns raised the accuracy to between 80 and 85 percent.  Since that point, the accuracy has increased only gradually.  The experience with the German coding was similar except that the initial accuracy was much higher.

In an informal experiment comparing KEDS to graduate student coders, we found that KEDS and human coder identification of the source in leads where both KEDS and the student found an event matched 93 percent of the time. This was virtually identical to the human-human agreement rate.  Human-KEDS agreement on the target was 81 percent, compared to 91 percent for human-human coding.  A similar 10 percent gap exists for the identical classification of the text into a WEIS category (Gerner, Schrodt, Francisco, and Weddle, 1992).  This difference in coding appears to be due primarily to sentences in Reuters that are too syntactically complex for KEDS to handle. Ambiguities in WEIS itself also account for some difficulties, although this affects both human coders and KEDS.[22]

The levels of agreement between KEDS and other human coders are at roughly the same level as in two inter-project coding comparisons reported by Burgess and Lawton (1972),[23] and are in the middle of the range of correlations between WEIS and COPDAB reported by Vincent (1983).[24] Our general assessment is that KEDS acts like a very careful, cautious, and somewhat inexperienced human coder.  To the extent that machine coding errors are random and event data are being used to measure an average value of some behavior — which is the typical use of this type of data — the substantial increase in the quantity of events that can be coded by machine greatly outweighs the small additional error in machine coding.

Schrodt and Gerner (1994) describe further analyses of KEDS's coding of events as compared with human-coded data.  We examined a 1982-1992 series on the Arab-Israeli conflict (23,127 events involving Egypt, Israel, Jordan, Lebanon, the Palestinians, Syria, and the United States) generated by KEDS-coded Reuters news leads and a human-coded WEIS series based on *The New*

*York Times* and *Los Angeles Times* for the same period.[25]  Although the two sets vary because of differences in the source as well as the coding method — and the KEDS-generated data has three times as many events as the human-coded series — we find that the two series correspond relatively closely for the forty-two directed dyads examined.  For example, there is a statistically significant correlation between the total number of events reported by the two data sets for 93 percent of the dyads.  For the number of cooperative events, 95 percent of the dyads show a significant correlation between the KEDS and human-coded data sets; the correlation for number of conflictual events is 55 percent.[26]  There is little *systematic* difference between the two series, other than that explained by the higher density of the KEDS data set, when we use the data for time series analyses.

We have also conducted research relevant to the validity of KEDS-coded data.  Gerner (1993) provides an extended discussion of the face validity of a KEDS-generated time series on the Arab-Israeli conflict (1982-1992) compared to historical narratives of political events during this period.  This research finds that the data set accurately identifies major trends in international conflict and cooperation in the region.  Both the overall levels of net cooperation/conflict and the patterns of specific types of interaction over time are generally consistent with the narrative record for each of the dyads examined.[27]  The data on Israeli-Palestinian net cooperation over time are particularly useful in summarizing that relationship.

We view KEDS as a tool — a technique for creating event data — just as survey research is a tool for generating data on public opinion.  For this reason we have devoted most of our attention to testing and improving KEDS's reliability — its ability to classify accurately natural language texts — and have accepted the WEIS categories as given in order to be able to compare our data with that of other WEIS-coded data sets.  The validity of the data created — the extent to which the measures are appropriate for the theoretical concepts of interest — is entirely in the hands of the individual user who determines the verb and actor lists and establishes the coding rules.  The determination of the equivalent sets of activities and actors must be guided by the specific theoretical question being asked.

The flexibility provided by machine coding has substantial implications for issues of validity in event data generally.  The existing human-coded event data sets were designed to be very general, since the events were coded only once.  In applications to theoretical questions involving concepts similar to those envisioned by the original researchers and their coders, the validity of the data may be high; however, if the questions are different, the validity could be quite low.  Machine coding, in contrast, allows a researcher to customize an event coding scheme to a specific theoretical question and, consequently, should provide for substantially higher validity.

For example, one of our colleagues used a variety of NEXIS sources and machine-assisted coding to generate an event data set of the 1980 attempt to rescue U. S. hostages held in Iran (Davis 1993).  Despite a fairly high density, the WEIS-coded events exhibit little variation because the

interactions consist almost entirely of three types of WEIS events:  *warning* (160), *unspecified threat* (171) and *nonmilitary threat* (172).  To the participants in the crisis, however, there were considerable gradations in threat (for example, whether Iran threatened to put the hostages on trial or threatened to move the hostages from the embassy).  Clearly these different types of threats could be distinguished using an appropriate set of verb phrases; event data coded with a customized scheme would probably be more useful than that coded with WEIS or COPDAB.

Similarly, the identification of synonymous actors may change.  In studying conflict in the Middle East, some research designs would require coding all PLO-affiliated Palestinian groups as PLO.  Others would distinguish between parties within the PLO (e.g., Fatah, Popular Front for the Liberation of Palestine, Democratic Front for the Liberation of Palestine), while still others might distinguish between individuals within those parties (such as the current split within the Democratic Front as represented by George Hawatmeh versus Yasir Abed Rabbo).

A final example of how machine coding can improve validity is the Protocol for the Assessment of Nonviolent Direct Action (PANDA) project of the Center for Nonviolent Sanctions at Harvard University.  This project is using KEDS to assist in coding a specialized data set dealing with nonviolent sanctions, a type of activity for which WEIS and COPDAB provide little differentiation.  The PANDA research group has developed a new coding scheme centered on the verbs and actors format used in KEDS plus supplementary human-coding on aspects of an event that KEDS cannot code.  The savings in labor provided by this machine-assisted coding will allow for the development of a specialized data set to study questions where the WEIS and COPDAB schemes would have had little validity.

## INTERNATIONAL AND REGION-SPECIFIC SOURCES

We experimented with coding one international news service, Reuters, and two regionally specialized foreign policy chronologies, *Journal of Palestine Studies* and *Informationen*.  Our objective was to compare the coverage of international and regional sources as well as to test KEDS on two different types of sources:  journalistic reports and specialized chronologies.

A number of studies have suggested that the North American and international data sources should be supplemented with regional sources.  For instance, Doran, Pendley, and Antunes (1973) find that Latin American sources report dramatically more incidents of domestic conflict than *The New York Times*.  Earlier experience with events data coding yields three more reasons to opt for news *agencies* over newspapers and for regional supplements to international sources.  The first is the well-documented seasonal and economic effects of advertising volume on the amount of news in a newspaper issue.  Second, newspapers focus on what the editors consider "newsworthy" at any given point.  Since the background level of activity is considered, an interaction that is judged significant enough to report one day might not be considered important at an earlier or later point.  Natural disasters (fires in Yellowstone National Park), political scandals (Iran-Contra), and civil strife

(Bosnia Herzegovina) are only a few of the many events whose occurrence can dwarf newspaper coverage of international interactions that under other circumstances would be included.[28]   News agencies such as Reuters are far less affected by these factors.  Finally, regional coverage is likely to be considerably more detailed than that provided by a global source.[29]

## Reuters

We examined several news services available through the NEXIS data service;  Reuters provided the most thorough English-language source covering the Middle East.  For most of the past decade, the Reuters reports were relatively short and a complex event (for example, a military engagement followed by condemnations, attempts to mediate and so forth) would be reported through a number of short stories, each with its own one-sentence "lead" that provided the gist of the article.  A typical Reuters lead reported by NEXIS is:

> 4.  Copyright (c) 1989 Reuters The Reuter Library Report, march 31, 1989, Friday, AM cycle, 224 words, ISRAEL SUMMONS CANADIAN AMBASSADOR TO DISCUSS PLO.  JERUSALEM, March 31, ISRAEL-CANADA, LEAD:  Israel has summoned the Canadian ambassador to protest Canada's decision to upgrade talks with the Palestine Liberation Organization (PLO), a Foreign Ministry spokesman said on Friday.[30]

NEXIS is searched using keywords arranged in Boolean statements.  To identify relevant events on the Arab-Israeli conflict, for example, we used:

> "HEADLINE(ISRAEL! OR JORDAN! OR EGYPT! OR LEBAN! OR SYRIA! OR PLO OR PALEST!)."

The "!" is a wild card character:  "PALEST!" will match "Palestinian," "Palestinians," and "Palestine;" "ISRAEL!" will match "Israel," "Israeli," "Israelis," and so forth.   This statement retrieves only a small number of totally irrelevant stories, primarily reports on international soccer, tennis, and cricket competitions and on basketball star Michael Jordan.  While we have focused on the leads, KEDS could, in principle, code the entire article sentence by sentence to find all subject-verb-object combinations that correspond to an event.  This would substantially increase the event density but would also contribute a great deal of redundant data, particularly in the WEIS "Comment" category.

## *Journal of Palestine Studies*

Since spring 1984, the quarterly *Journal of Palestine Studies* (*JPS*) has maintained an ongoing chronology focusing on "events within the Palestinian community, wherever it is (Israel, the occupied territories, other Arab countries, the US, Europe, etc.), and on actions and actors that affect this community.  Priority is given to occupied Palestine/Israel, with secondary emphasis on the Arab world and other countries"  (*JPS* 14:1, Fall 1984: 216).  There are other Middle East chronologies, such as in *The Middle East Journal*; however, the one in *JPS*  deals most comprehensively with the

Arab-Israeli conflict, an issue in which we had a substantive interest.  The sources used in compiling the *JPS* chronology have varied over the years.  Initially, the chronology was created from articles in *Mideast Press Report*,  a weekly clipping service published by Claremont Research and Publications, Inc. that monitored more than eighty U.S., European, Israeli, and Arab English-language publications.  From Winter 1987 (16:2) until the present, the chronology has been compiled by staff of the *Journal of Palestine Studies*, drawing on a number of different sources:  Israeli, Palestinian, regional, and international media.[31]

The following are some examples of text from the *JPS* chronology.  (The information in brackets gives the original source of the report.)  In general *JPS* reports are more abbreviated than Reuters leads and often a single report will contain multiple events.

> 9-year-old Palestinian from Tulkarm camp dies from wounds received previous week; in wake of death riots break out in Tulkarm camp, 3 Palestinians are injured [FBIS 5/2, FJ 5/8].

> In Tulkarm Palestinian accused of collaborating is stabbed, killed [FJ 5/8].

> Israeli authorities prevent Palestinians from Occupied Territories from entering al-Aqsa mosque to celebrate Leilat al-Qadr (the night the Qur'an was revealed) [FJ 5/8].

> Secretary of State Baker sends Shamir, Rabin letter suggesting that Palestinians outside of Occupied Territories be allowed to participate in Israeli-proposed elections [FBIS 5/12].

The text from *JPS* was converted to a machine-readable form using a scanner and optical-character recognition (OCR) software with human editing and correction.  Because *JPS* uses a complex typographical format, with multiple fonts and frequent mixing of conventional, italic, and bold typefaces, the error rate before editing was about 10 percent.  This was further complicated by the multiple column format of the text and the fact that the pages of the journal did not lay flat against the scanner.[32]

### *Informationen*

The second regional source for this project was *Informationen*, a German-language chronology published fortnightly between 1986 and 1991 by the Ministry for Inter-German Relations of the Federal Republic of Germany (FGR).  The German chronology promised to provide greater density than Reuters, at least for the two Germanys and their relations with Soviet-bloc states.  Until the unification of the two German states, *Informationen* provided detailed reporting of both major interactions and low-level international visits, agreements, and conflicts.  While the coverage tended to be focused on domestic and international events in the "other Germany," the German Democratic Republic (GDR), the West Germans always understood that their national problem could only be solved within the context of an East-West accommodation.  Thus the scope of the coverage was remarkably broad.

The following are some examples of the *Informationen* text:

> Bundesaußenminister Hans-Dietrich Genscher und sein DDR-Amtskollege Markus Meckel nehmen in Ost-Berlin an der konstituierenden Sitzung einer gemeinsamen Kommission beider Ministerien teil, die die Außenpolitik der beiden deutschen Staaten bis zur Vereinigung koordinieren soll. Genscher wird von der DDR-Volkskammerpräsidentin Sabine Bergmann-Pohl zu einem Gespräch empfangen.
>
> Die DDR-Ministerin für Handel- und Tourismus Sybille Reider wird in Bonn von Bundeswirtschaftsminister Helmut Haussmann zu einem Gespräch empfangen.
>
> In Erfurt beginnt eine innerdeutsche Ausstellung unter dem Motto "Umwelt 90", die im Auftrag des DDR-Ministeriums für Umwelt, Naturschutz, Energie und Reaktorsicherheit präsentiert wird.

*Informationen* was also scanned and proved much easier for OCR software to deal with than was *JPS*: the text required little correction after it had been edited using a German-language spelling checker program.

## COMPARISON OF REUTERS AND *JPS*

We examined a twenty-four month period — January 1989 through December 1990 — to identify similarities and differences in coverage between the *Journal of Palestine Studies* and Reuters.  Surprisingly, there is relatively little overlap in the specific events included in these sources.  The *Journal of Palestine Studies* is strongest in its coverage of internal Palestinian politics, Israeli-Palestinian relations, and the use of force by Israelis against Palestinians.  Thus *JPS* frequently reports more events than Reuters in WEIS categories such as *reduce relations*, *seize*, or *force*.  At the same time, the *JPS* coverage of the broader Arab-Israeli conflict is not as comprehensive as is Reuters' coverage.  In particular, the latter is more likely to report international diplomatic activities, such as events classified *comment*, *consult*, *promise*, *propose*, *reject*, or *accuse*.[33]  This pattern is true for each of the twelve dyads examined.[34]

**FIGURE 1**
**Total Events Per Dyad Reported by Reuters and JPS**
**January 1989 - December 1990**
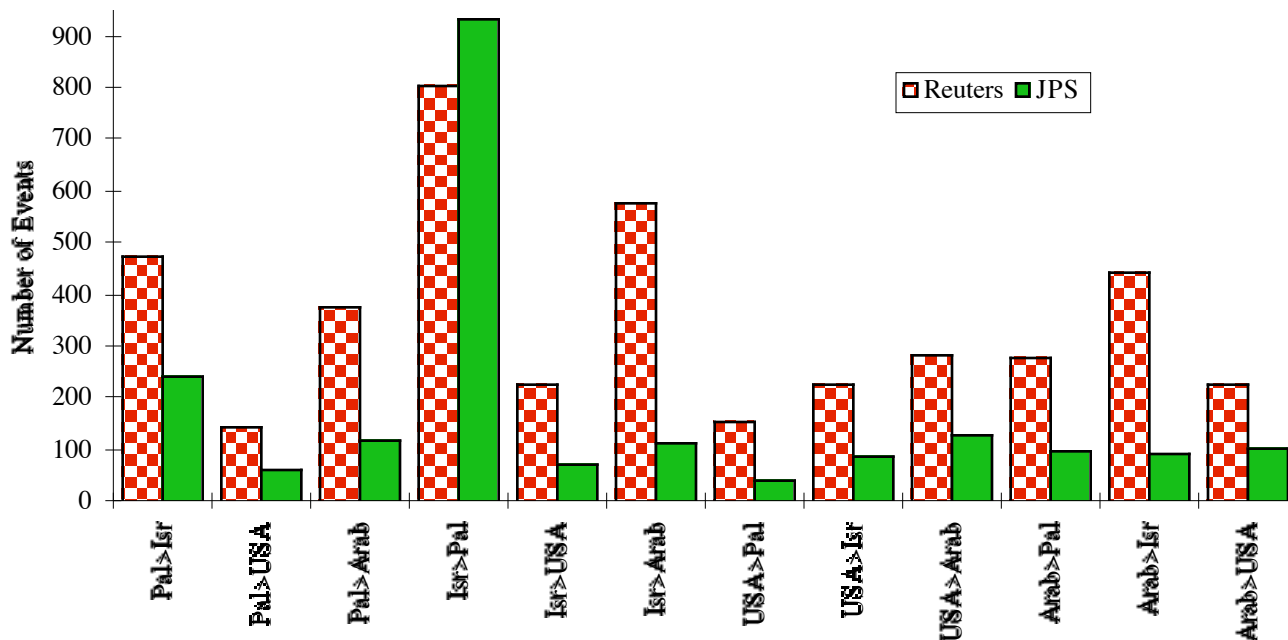


Based on preliminary tests, we expected that *JPS* would record a larger number of events dealing with the Arab-Israeli conflict (and especially with Palestinians) than Reuters. This did not prove to be the case: Reuters reports more events for each dyad except Israeli actions toward Palestinians (see Figure 1). In some cases, the difference was quite significant. For example, Reuters reported five times as many Israel events toward Arab states and four times as many Arab events toward Israel as did *JPS*. This may be in part a function of the way the two sources record events. Reuters often repeats stories throughout the day with only minor changes; KEDS does not always recognize these multiple reports as describing the same event and may code them more than once. In contrast, *JPS* frequently describes a set of several interactions in such a way that KEDS codes only a single event. However, a dyad-by-dyad examination of the differences in the extent of Reuters-versus-*JPS* reporting suggests that Reuters generally picks up a greater percentage of the total events than does *JPS*.

Figures 2.1 and 2.2 illustrate this pattern for Reuters and *JPS* reporting by month over a two year period. Reuters reports more events per month than does *JPS* for virtually every dyad except Israeli actions toward Palestinians.[35] On the other hand, for a majority of the dyads there is a clear, statistically significant correlation between the number of events reported by Reuters each month and

the number reported by *JPS* (see Table 2).  The correlations were particularly strong for two dyads: Israeli actions toward Palestinians and Arab actions toward the United States.  There are several occasions when the number of events reported by the two sources is almost identical.  When we examined the specific events reported in these months, we found that they tended to include actions of great salience to the Palestinians (regardless of whether they were directly involved) as well as to the international community as a whole.  Thus, both Reuters and *JPS* reported them.  In contrast, Reuters frequently reports events that *JPS*, for whatever reason, does not view as significant and therefore ignores.

---

**TABLE 2**

**Correlation of Total Monthly Events Reported by JPS and Reuters**

|                      | Palestinians | Israel   | US       | Arab Actors |
|----------------------|--------------|----------|----------|-------------|
| Palestinians toward  | ---          | .26      | .54 **   | .40 *       |
| Israel toward        | .62 ***      | ---      | .45 **   | .04         |
| US toward            | .45 **       | .56 **   | ---      | .35 *       |
| Arab Actors toward   | -.08         | .49 **   | .72 ***  | ---         |

\*    Significant at the 90% level   \*\*   Significant at the 95% level      \*\*\* Significant at the 99% level

---

**FIGURE 2.1**
**Israeli Actions Toward Palestinians As Reported by Reuters and JPS**
**January 1989 - December 1990**

**FIGURE 2.2**
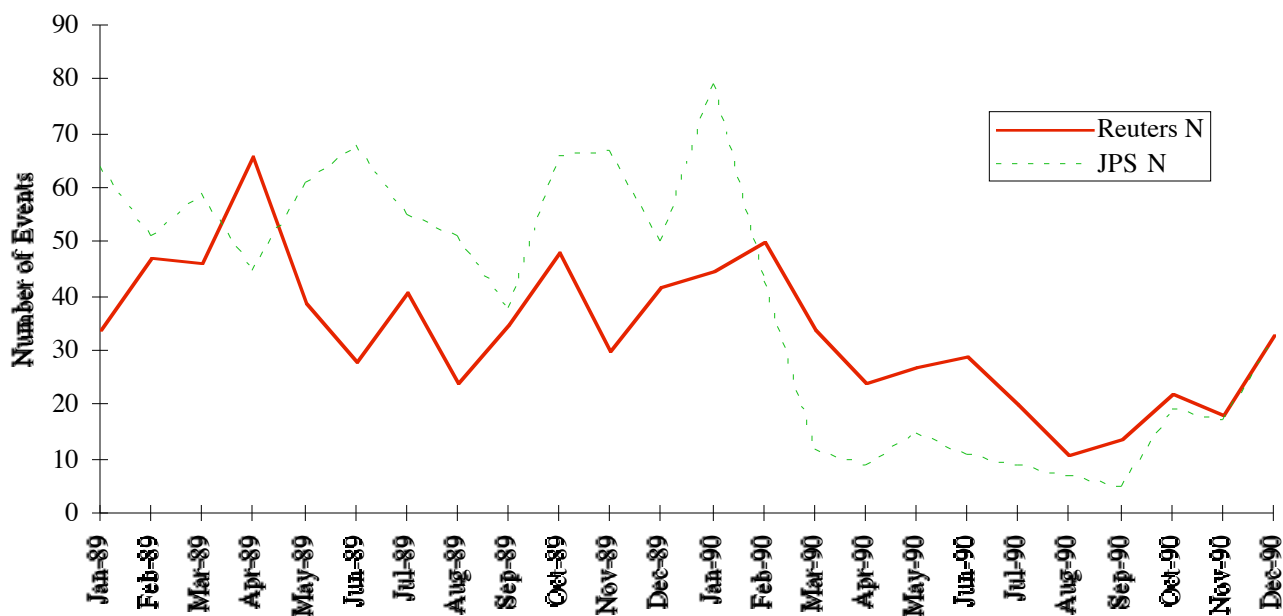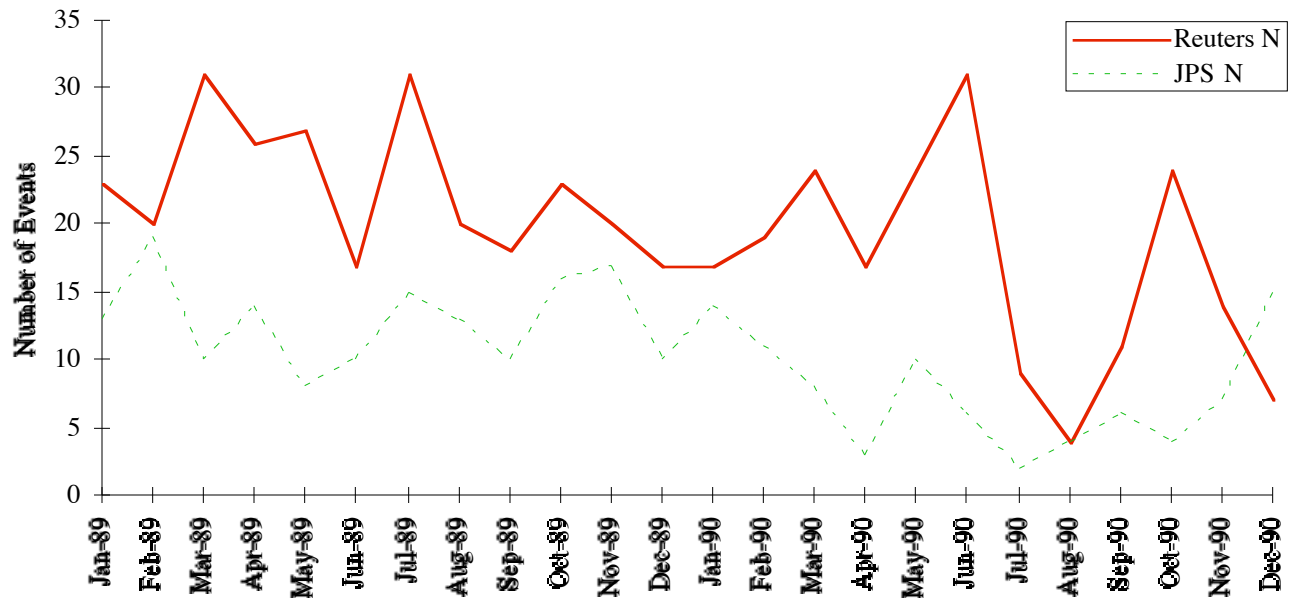**Palestinian Actions Toward Israel As Reported by Reuters and JPS**
**January 1989 - December 1990**



The other major finding from our work with *JPS* was the need to customize the vocabulary. Initially we attempted to code the chronology using the Reuters actors and verbs list. The accuracy plummeted to 30-40%, however, due to two features of *JPS* reporting. First, *JPS* text is recorded in the present tense while Reuters uses past tense, requiring the expansion and modification of the verb pattern files. This was a conceptually straightforward task. The issue of implicit knowledge regarding the actors was somewhat more problematic. Since *JPS* concentrates on events involving Israel and the Palestinians, these actors are often not explicitly stated in the text as a way to save room. The following report is typical:

> Army seals 2 houses in Gaza. 2 Palestinians from Burayj camp are killed in clash with soldiers. Army gives unit commanders power to close area of Occupied Territories without explanation.

To correctly code this, the vocabulary list had to be modified to indicate for instance, that "army" meant Israel and "Occupied Territories" meant Palestinians. As a result, we concluded that a separate vocabulary list was required for coding *JPS* and that this list could not then be used on the Reuters files. The implication is that machine coding not only can, but often must, be tailored to fit specific sources.

We do not, however, see this as raising deep philosophical issues on alternative meanings of language, as some might suggest, but instead believe it is primarily a practical problem. Specialized

sources require adjustments in any form of event coding.  One would have to tell a new human coder unfamiliar with the Middle East that "army" really meant "Israel" just as it is necessary to "tell" KEDS.  By building implicit knowledge of this type into the specialized KEDS vocabulary lists we can maintain the reliability of the coding while increasing its validity.  In contrast, the use of external knowledge for interpretation by a human coder could distort the reliability of the classification since that knowledge could vary from coder to coder and might not be applied consistently.

## COMPARISON OF REUTERS AND *INFORMATIONEN*

The KEDS program required few modifications beyond the creation of German vocabulary lists in order to code German language materials.  We developed additional rules to deal with passive voice and modified the program to scan the entire sentence for verb patterns since the German verbs indicating event codes tend to occur at the end of the sentence.  (In English, KEDS stops at the first verb that matches an event pattern unless it is coding a compound sentence.)  *Informationen* is written in "bureaucratic" (*amtliches*) German, which is more formal and less ambiguous than Reuters journalistic English; this, in combination with the more limited political behavior found in Central Europe, meant that coding *Informationen* proved to be substantially easier than coding the English-language Reuters text for the same period.  The German vocabulary needed to code accurately is also substantially smaller (about 300 verb phrases) than that required by Reuters because German does not have the multiple verb roots of English.[36]

We compared the coverage of Reuters and *Informationen*  for the two-year period January 1987 to December 1988.  As Figures 3.1 and 3.2 illustrate, this chronology provides substantially more events involving the GDR than does Reuters.[37]  The coverage of inter-German events is particularly dense:  The FRG government encouraged the creation of contacts and agreements at all levels of German society as a means to foster normalization, if not reunification.  Thus, the Ministry chronicled virtually every agreement on transport, cultural exchange, scientific cooperation and even sixty sister-city accords (the last were not coded as events).

**FIGURE 3.1**
**FRG Actions Toward the GDR as Reported by Reuters and Informationen**
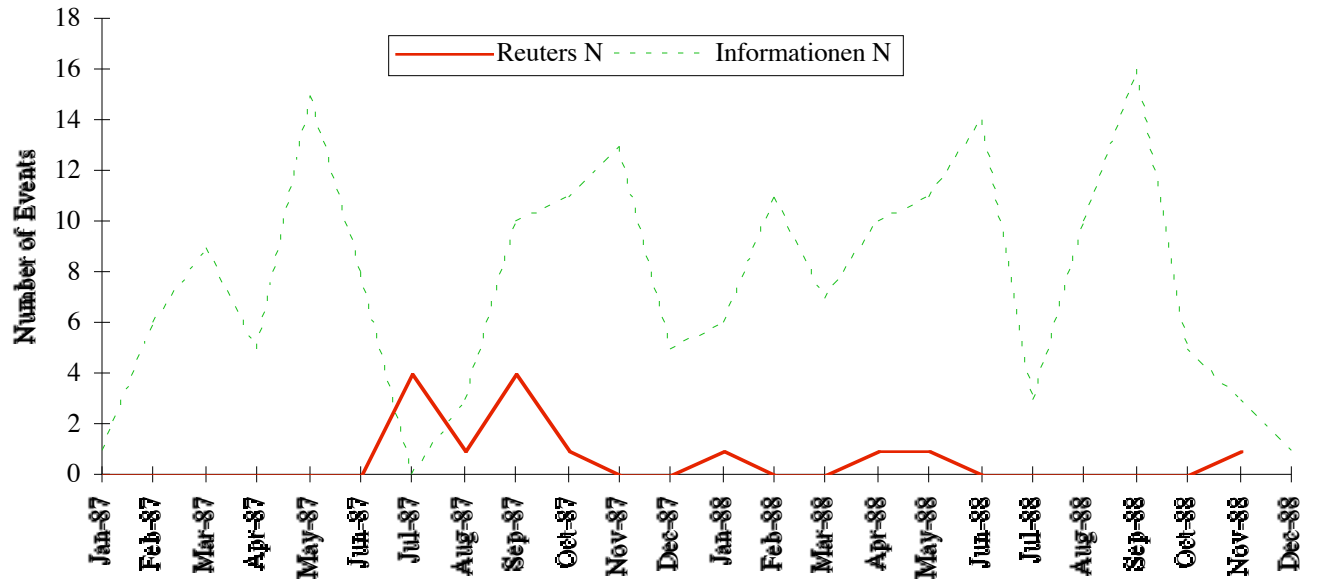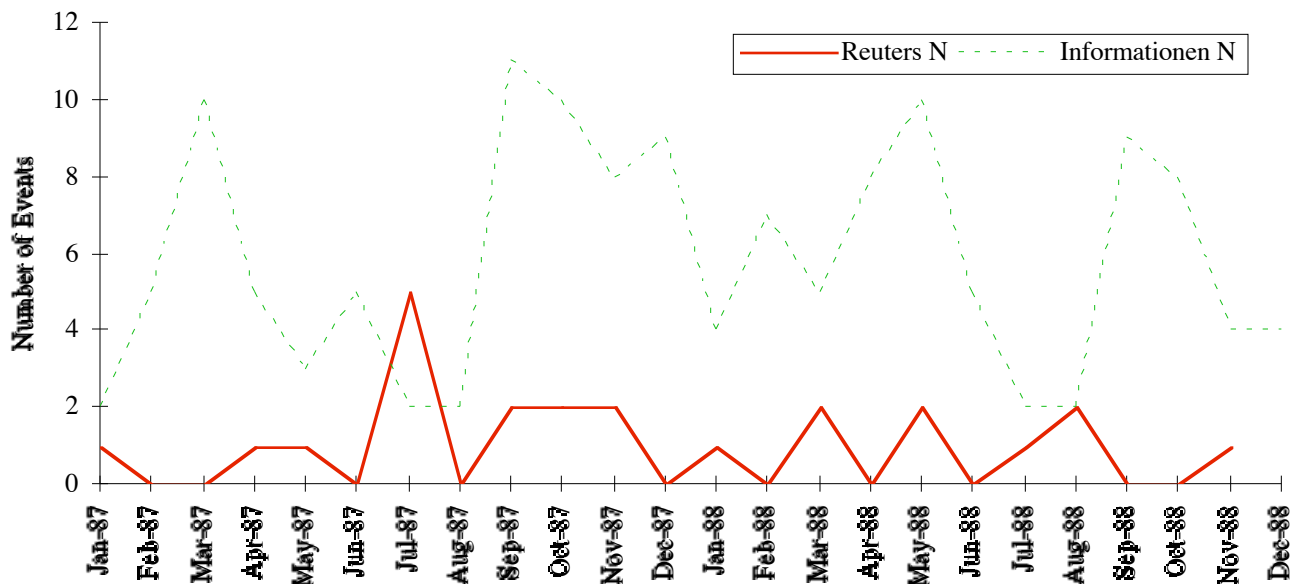**January 1987 - December 1988**

**FIGURE 3.2**
**GDR Actions Toward the FRG As Reported by Reuters and Informationen**
**January 1987 - December 1988**



The content of *Informationen* raises an issue relevant to the collection of event data more generally.  Because *Informationen* attempts to capture *all* GDR foreign policy events, its modal WEIS categories are predominantly in the lower range, i.e., WEIS 03 (*consult*) or 08 (*agree*) codings.  Traditional international relations researchers deemed these data only marginally useful. As German reunification demonstrated, however, mundane meetings and agreements formed a critical part of a West German strategy that was successful in the long term.

As we found with *JPS*, *Informationen* is a specialized source focused on one country's activities.  There is no attempt to cover both Germanys.  Hence, Reuters is a far better source for West German events.  *Informationen* is unmatched for its coverage of inter-German events, however, and for an intense focus on one country's relations with the Warsaw pact, the Council for Mutual Economic Assistance, and the Soviet Union.[38]  The *modus operandi* of these contacts were meetings and agreements.

The specialized character of *Informationen* limits its utility in research, since we do not presently have a comparably detailed record for the actions of any other governments.  Therefore, one could not use these data to answer the basic question "does low-level, long-term cooperation deter conflict?" in a comparative fashion, although some limited exploration of the issue could be done with a time-series design.  Other sources are emerging, however, and KEDS's ability to code in

almost any natural language provides an opportunity to escape the English-language parochialism of most current event data sets. Serious electronic newsletters exist in East-Central Europe for Poland (*Donasy*) and the Czech Republic and Slovakia (*Carolina*). The U.S.-funded Radio Free Europe and Radio Liberty daily reports have also been available electronically since 1992.

## SUMMARY AND IMPLICATIONS

This section will address three points raised by this project: the utility of machine coding, the implications of the use of alternative sources, and some general observations about extending event data.

### Machine Coding

Our experiments indicate that the generation of event data by machine, at least within the WEIS framework, is not only possible but relatively easy. While the methods used with Reuters and the specialized chronologies would not work on less structured text such as political rhetoric, being able to code Reuters alone provides a substantial improvement over the existing event data sets.[39] Our experience coding a language other than English has also been very encouraging and opens the possibility of reducing the heavy reliance of most current event data collections on English-language sources.

When we originally embarked on this project, our objective was to develop a system that could replace human coders by achieving a human/machine reliability in the 85 percent range. With a single coder, source, and region, this turned out to be surprisingly straightforward. We are currently using about 1000 patterns in the English coding; comparable natural language projects use around 3000 patterns for English (see Lehnert and Sundheim 1991), so it is likely that a KEDS or a system based on similar design principles could achieve a human/machine reliability in excess of 90 percent with a suitably large vocabulary.

Machine coding may be useful for generating specialized data sets from regionally-specific or historical sources that might not otherwise be coded due to the labor involved. The preparation of the input text can be done by individuals without special training, such as work-study students or university word-processing centers; specialists can focus on the coding itself. This same task differentiation applies to material in languages other than English: the expertise of a multi-lingual coder can be concentrated on the difficult cases.

At the present time we have worked primarily with NEXIS and OCR. While both sources provide the potential for large amounts of data, they are relatively slow and awkward to use. NEXIS data must be downloaded through a modem, which is time-consuming for the amount of text involved, and at some institutions involves a per-citation fee. OCR is much quicker than manual entry, but is still labor-intensive and somewhat error-prone.[40]

Over the past two years, a substantial number of sources of news text have become available on CD-ROM. For example, the full text of *The New York Times* is available on CD-ROM for 1991

and all subsequent years; the Dialog information service also provides the full text for a number of newspapers on CD-ROM.  University Microfilm Inc. produces a CD-ROM that contains abstracts of a number of US newspapers, including *The New York Times*, *Wall Street Journal* and *Washington Post*.  *Facts on File,* which has been used in some event data collection projects, has produced a CD-ROM covering 1979-89.  Wayzata Technology recently introduced a *Front Page News* CD-ROM that includes a number of different news wire sources, including some of the Reuters news wires; thus far this disk is available for 1990 and 1991.  Since the marginal cost of producing a CD-ROM from electronically-stored text is very low, presumably Reuters and other news agencies will provide this service in the near future.[41]

## Region-Specific Sources

We experimented with regional sources for three reasons:  to determine if the English vocabulary developed for Reuters would transfer to another English-language source; to learn whether KEDS could be used to code a language other than English; and, finally, to establish the extent to which there were systematic differences between an international source such as Reuters and region-specific sources.

The process of modifying the Reuters vocabulary to handle *JPS* showed that the patterns used are somewhat source-specific; it also showed that specialized chronologies may be more difficult to code than journalistic sources because the chronologies assume more implicit knowledge.  These limitations can be overcome by changing the coding patterns but argue against using those patterns on new sources without modification.  The differences between Reuters and other journalistic sources such as *The New York Times* or *Washington Post* are likely to be less significant than the differences with *JPS*.

The experience of coding a German-language source was quite positive and the ease with which KEDS could be modified from coding English to coding German appears to validate the KEDS approach of using limited, rather than full, parsing.  A machine coding system may require only the ability to handle dictionaries of general actor and verb patterns, conjunctions, pronouns, and rules on verb placement; these are much simpler requirements than constructing a full parser for each new language.  Bureaucratic German also proved to be much easier to code than journalistic English because of the more rigid structure of that language.  The logical next step in testing this approach would be to use the system with a language outside the Indo-European family, such as Arabic or Japanese, provided a suitable machine-readable data source can be found.

The distribution of events provided by the specialized sources is quite different than that of a journalistic source such as Reuters.  The specificity of those sources was somewhat unexpected: Both *JPS* and *Informationen* were much more highly focused than Reuters.  This characteristic would need to be considered in any study using such specialized data sources.  We had expected the

regional sources to pick up all of the interactions coded in Reuters but this proved not to be the case: International and regional sources can be quite different.  If a wide variety of specialized chronologies could be identified and coded, an event data set with significantly higher density than that created from either *The New York Times* or Reuters could be obtained.  In situations where only regional event data were needed, a small number of specialized sources might be sufficient.

### The Future of Event Data

There are two fundamental reasons for continuing to pursue event data.  First, politics does not have the convenient numerical measures such as location, momentum, and temperature found in physics, or price, interest rates, and GNP found in economics.  Political activity, instead, consists largely of discrete actions and communications directed from one actor to another over time.  McClelland's (1970) original observations on the potential utility of event data as a method of partially addressing this situation still hold.

Second, human analysts have a limited ability to absorb vast quantities of largely redundant material.  The text of NEXIS news wire leads covering only Israeli-Palestinian interactions for 1989 runs to some 300 pages.  The full articles would fill perhaps 2000 pages; we suspect that few researchers would read these cover-to-cover.  The task becomes even more formidable if one is dealing with a long time series such as the Cold War: just what were the USA and USSR doing on 16 August 1955?  While most human analysts can memorize the day-to-day details of a short time period such as the Cuban Missile Crisis, or the major events of a long period such as the Cold War, we are skeptical about the human ability to memorize, much less analyze, day-to-day details for a long time period.  Event data fill that gap.  The text of the journalistic sources provide memory and a variety of statistical and other computational methods can provide analysis.  Between the text and analysis, one needs something similar in content to event data.

A recent issue of *Science* surveyed how a number of new techniques in the physical and biological sciences had revolutionized not just the methodologies, but also the theories, within their fields.  The article observes:

> Yet not everybody appreciates the importance of technique.  Many scientists, in fact, are "theory snobs" who dismiss technique as a kind of blue-collar suburb of science. . . .  [But there is,] clearly, enormous transforming power in techniques.  In the absence of an essential technique, a researcher or a field flounders, developing elegant theories that cannot be decisively accepted or rejected — no matter how many intriguing circumstantial observations are available.  But with a key technique in hand, the individual and field move ahead at almost terrifying speed, finding the right conditions to test one hypothesis after another.  Conversely, new techniques often uncover new phenomena that demand new theories to explain them.  (Hall 1992: 345)

International relations, and much of comparative politics, is arguably theory rich and data poor.  In contrast to our colleagues in U.S. and European politics, who have access to data from numerous

governmental sources such as the Bureau of the Census, Bureau of Labor Statistics and Department of Justice, as well as the massive public opinion surveys of the U.S. National Election Study and Euro-Barometers, we have very few data on international and substate interactions.  Much of the data we do have are a decade or more old.  At the same time, the interactions in international system are becoming more complex with the end of the Cold War and the need to be able to study systematically alternative theoretical explanations for that behavior is greater than ever.

Gaddis (1992/93) provides a thorough discussion of the failures of both scientific and traditional analytical techniques to predict the end of the Cold War.  While Gaddis, an historian, suggests that behavioralists need to pay more attention to history and less to the models of the physical sciences — an observation with which we wholeheartedly concur — he also notes that the traditional analysts did no better on this problem than the behavioralists.[42]  In another context, Khong notes of the advisors who produced the disastrous United States policy in Vietnam: "Critics who lament that the policymakers knew too little history might ponder if a more distinguished and knowledgeable group of officials has since been assembled by any president"  (1992:257).  Event data have their problems, but so do historical and traditional narrative approaches.

The failure to predict the end of the Cold War has demonstrated the problems of traditional and scientific techniques in a complex world and should, although probably will not, spawn an urgent search for new methods, just as the Great Depression revolutionized macroeconomic theory and analytical techniques.  It is our belief that event data and related approaches involving the systematic and reproducible analysis of large amounts of text describing political behavior should be an important part of this search.  Past event data projects, constrained by finite budgets, devoted most of their efforts to data collection, leaving little time for the development of new models, analytical techniques, or even the refinement of coding schemes.  Machine coding dramatically reduces the labor involved in coding and allows researchers to develop coding schemes valid for specific theories.  At the same time, new computational techniques such as models of narratives, sequence analysis techniques, and statistical time series methods allow event data to be analyzed in far more sophisticated ways than most past research, including our own.

Event data are obviously not the only way to test theories, but they provide a starting point. The collection of data divorced from theory is not good scientific practice but the development of theory divorced from data is not scientific at all.  With new computer technologies and new sources of machine-readable reports of political events, we believe that there is considerable scope for expanding the generation and analysis of event data in the 1990s.

# NOTES

[1] The advantages and disadvantages of event data have been extensively analyzed in the international relations methodology literature (Azar, Brody, and McClelland, 1972; Burgess and Lawton, 1972; Azar and Ben-Dak, 1975; Peterson, 1975; Munton, 1978; Howell, 1983; Vincent, 1983; McClelland, 1983; Merritt, 1987; Merritt, Muncaster, and Zinnes, 1993; and Schrodt, forthcoming).  Marlin-Bennet and Roberts (1993) discuss the use of event data in research.

[2]  The RADIR (Revolution and the Development of International Relations) studies in quantitative semantics were among the important precursors to McClelland's work.  Four of these reports from the early 1950s are reprinted in Pool (1970).

[3]  WEIS is based on *The New York Times*; COPDAB uses *The New York Times* and a number of regional sources.

[4] John Davies (University of Maryland) is currently supervising a major project — Global Event Data System (GEDS) — that is coding Reuters wire service news stories using the COPDAB framework.  This data set begins in 1990.  Davies and McDaniel (1993) describe the GEDS research effort in detail.

[5] See Inter-University Consortium for Political and Social Research (1991:202-204).  Most of these focused data sets appear to have been experiments funded by DARPA during the early 1970s; a number of them use the WEIS coding scheme.

[6] Laurance (1990) presents an excellent history of the "rise and fall" of event data analysis in the policy community, with particular emphasis on institutional factors that have hindered widespread acceptance of the methodology.

[7] For example, Goldstein and Freeman's (1990) event data analysis of U.S.-Soviet-Chinese relations used a WEIS data set from McClelland covering superpower relationships from 1966 to 1986 and a WEIS-coded data set from Ashley (1980) covering 1950-1972.  Neither set is available from the ICPSR.

[8] Since the *World Handbook* itself contains event data, the total citations to event data are probably greater than those to the non-event data parts of the *World Handbook*.

[9] The draft coding manuals of contemporary GEDS and WEIS projects provide considerably more information than these earlier efforts.  For example, both Davies (1991) and Tomlinson (1993) spend about a page and a half describing what constitutes an event.  In the GEDS manual, Davies emphasizes in bold face:

> an event must have an actor, action and target [and] involve human actions, rather than "acts of nature" or description of the natural consequences of human action.  . . .  To be codable, an event must also be locatable in time and space. . . .  Events thus involve observable behavior, whether verbal or non-verbal. . . . events which are of human or local interest only, rather than being of national or international significance, should not be coded.  (Davies 1991:8-9)

This definition is consistent in spirit with the one we propose and avoids the problems of inferring motive and importance present in the earlier COPDAB definitions.  The contemporary codebooks continue the practice of defining the event categories using short lists of verbs, verb phrases and noun phrases.

[10] As a matter of record, while this definition appears to be designed to justify machine coding *a priori*, it is actually a consequence of two years of experiments with machine coding and the gradual realization that interactions that do not meet this criteria are likely to be ambiguous to humans as well as machines.

[11]  This approach, which assumes a certain level of uniformity and translatability in human-language-based discourse, is well-grounded in the psycholinguistic literature (e.g., Osgood, 1971).

[12] Transitive verbs are those that can take a direct object and indirect object.  For some events, the second actor is the direct object of the sentence ("Syria accused Israel . . ."); in other cases, it is the indirect object ("Saudi Arabia promised economic aid to Syria").

[13] The main missing aspects are geographic location of the event (often but not always the same as the target) and issue area or domain.  We have not attempted to include any functions in KEDS for coding issue areas since our source text consists only of Reuters lead sentences and in Reuters stories the issue area is often not mentioned until later in the story.  To the extent that issue areas are unambiguously defined, however, there are a variety of computational text processing methods that could be used to code them (e.g., Salton,1989: chapters 9 and 11; the

projects discussed in Sundheim, 1991).  One could, therefore, develop a explicit set of "issue areas" similar to the vocabulary lists for actors and actions.  The KEDS program also allows for the human-assisted identification of event location.

[14] For example, one can imagine a situation where an area had a substantial amount of economically motivated banditry as well as politically motivated guerrilla activity but where the government press referred to all violent activity as the product of "bandits" as a way to delegitimize the guerrillas.

[15] A variety of such techniques are discussed in the computational modeling literature (e.g., Sylvan and Chan, 1984; Cimbala, 1987; and Hudson, 1991).

[16] The program currently runs on Macintosh computers with at least 2Mb of memory, has a regular Macintosh interface, and is designed to be used by individuals with modest computer experience.  A version for DOS computers will be available in the future.  The Macintosh program and its vocabulary files are available from Schrodt.

[17] Lenert and Sundheim (1991) and Sundheim (1991) discuss the relative merits of simple pattern recognition with sparse parsing versus full linguistic parsing in coding political information from wire service sources.  Sparse parsing looks only at simple syntactic elements; for example, the fact that subjects precede verbs.  This is easier than fully parsing the sentence but avoids the problems associated with simply counting words using no syntactic information at all.  Salton (1989) provides a general introduction to computational text processing; Joshi (1991) contains a survey of the current state of the art with extensive bibliographic references.

[18] We use the term "source" to refer to the initiator of an action.  In much of the event data literature this is called the "actor," a word we reserve for the set of entities that can be sources or targets.

[19] For example, Alker (1988:224) reports a case from an early event coding project where the codes assigned by a female coder from a Third World country were "unreliable" compared to those of male, United States coders due to the different backgrounds of the coders.  We suspect, if it was possible to do such an experiment, that one would find equally large differences in white male upper-middle-class coders working during the Vietnam protest years as compared to those coding during the early Reagan years.

[20] Jervis (1976), Lebow (1981), Vertzberger (1990), Khong (1992), and many of the articles in Hudson (1991) and Singer and Hudson (1992) describe the psychological distortions that occur in the human analysis of political events.  Gerner (1991) provides a general discussion of this literature.  It stretches credibility to assume these psychological factors will not also have an effect on human event data coders.

[21]  In 1988, China's military budget was $20 billion while Japan's was $24 billion.  In terms of military expenditure per capita, Japan outspent China by a factor of ten (ACDA 1989).

[22] Examples of sentences that are too complex for KEDS to code include the following:

"The United States on Friday dismissed Israel's apparent rejection of an Egyptian plan for talks with the Palestinians as 'parliamentary maneuvering' and said the door was not closed to peace."

"Resumption of ties between Egypt and Syria may spur reconciliation between Iraq and Syria, and Syria and the PLO, the Qatari newspaper al-Raya said on Friday."

Sentences whose syntax is too complex, or too idiosyncratic, for KEDS to handle probably account for five to ten percent of the cases in Reuters.

[23] Fifty-six percent for a test involving Rummel and three assistants; 42 percent for recoding WEIS by Macalester College undergraduates.

[24] These correlations — which are different from event-by-event agreements but still comparable in terms of general magnitude — range from an average of 0.84 in 1966-1969 to 0.45 for 1970-1975.

[25]  The human-coded WEIS data set was provided by Rodney Tomlinson at the U.S. Naval Academy (Tomlinson 1993).  These data have been collected by McClelland and several of his students.

[26] Many of the dyads with low correlations have a very small number of events in the WEIS series. If we examine only dyads for which WEIS reports an average of one event per month, the percentage of significant correlations is 95 percent for total events, 100 percent for cooperative events, and 84 percent for conflictual events.

[27] Net cooperation was calculated by weighting each WEIS event as described in Goldstein (1992) and totaling the events for each month.

[28] A brief example illustrates this problem. *The New York Times* coverage of the Palestinian *intifada* dropped off dramatically in November and December 1989 when U.S. media and public attention shifted to the political transformation of Eastern Europe. Yet, as Gerner can verify on the basis of direct personal observation as well as a review of indigenous news sources and the data collected by local human rights organizations, the actual level of Israeli-Palestinian interactions did not decline during these two months. Scholars using only a *New York Times*-based event data set to examine the *intifada* could be badly misled.

[29] Echoing the earlier results of Doran et al. (1973), Brockett (1992) finds that the *World Handbook* data on domestic political violence in Central America contain gross and systematic errors that probably extends to the entire Third World. Taylor and Jodice (1983) were restricted by cost constraints to international sources and used no indigenous regional sources for Latin America or Africa. Thus one of the most lively research areas in comparative politics, the effect of land inequality on political violence (Muller, Seligson, Fu, and Midlarsky, 1989), may rest on flawed data for the dependent variable.

[30] This format changed beginning in 1992: the new citation form contains only a very abbreviated abstract of the article. We now download using the NEXIS "HLEAD" format, which typically provides the lead sentence plus one or two additional sentences.

[31] For details on the construction of the *JPS* chronologies, see Gerner et al. (1992:26-27).

[32] We were using OmniPage version 3.0 with a Macintosh IIsi. There has been considerable progress in OCR technology during the past two years and recent programs are reportedly far more accurate.

[33] *JPS* often includes verbatim transcripts of important international diplomatic statements in its documents section but then does not mention these in the chronology.

[34] Gerner et al. (1992:33-34) present figures of event counts by WEIS category for each of the twelve dyads examined.

[35] Gerner et al. (1992:30-31) provide figures of the Reuters and *JPS* event counts by month for each of the twelve dyads examined.

[36] English and German belong to the same sub-family of the Indo-European languages (Germanic) but the progenitors of Old English and modern German diverged about 2000 years ago. Modern English arose from the London dialect of Middle English around the time of Shakespeare, and was heavily influenced by the Norman French introduced by political elites following the Norman conquest, and the Latin and Greek of Renaissance intellectuals. Consequently at KEDS's level of linguistic sophistication, modern English has much more in common with Romance languages such as French and Spanish than it has with German (e.g. in verb placement and the deemphasis on noun cases). Because most transitive verbs in English can be expressed using either a Germanic root or a Latin root (e.g. take/accept, meet/visit, give/ present), the basic vocabulary required for English is substantially greater than that required for most languages.

[37] The other six dyadic relationships examined are illustrated in Gerner et al. (1992:35).

[38] Figures showing the types of events reported by Reuters and *Informationen* are given in Gerner et al. (1992:37).

[39] It is possible to create systems to process more complex texts, but only if one limits their substantive domain. For example Alvarado's OpEd program (1990) "understands" editorials on issues in political economy; Kolodner's CYRUS (1984) deals with the official activities of Secretary of State Cyrus Vance and Pazzani's OCCAM (1988) deals with international economic sanctions. The performance of such systems is quite impressive but they are dependent on a large amount of domain-specific knowledge and can only work with text dealing directly in that domain. OpEd, for example, required prior editing "to remove . . . issues that fall outside of OpEd's process model, such as understanding references to historical events, completing analogies and handling sarcastic or humorous statements" (Alvarado, 1990:3).

KEDS, in contrast, deals with unedited source texts in two different languages covering a very wide range of political behavior. KEDS cannot deal with that material in much depth, but its processing appears adequate for event data coding. The tradeoff between complexity and specificity is widely encountered in artificial intelligence: programs either perform complex tasks in limited domains or simple tasks in broad domains, but not both. This is true in technology in general. Almost any hammer can be used to pound almost any nail, but you can't use the remote control for a VCR to program a microwave oven.

[40] In addition to using OCR with contemporary texts, we also experimented with historical texts. Our original objective was to generate an event data time series using *The Times of London* coverage of the Arab Revolt of 1936-39. *The Times* is available on microfilm; we made photocopies of this using a microfilm copier, then attempted to read the text using the OCR software. This did not work. The original microfilm copies contain a great deal of noise in the form of spots and breaks in the type; these thoroughly confused the software and the resulting text probably has an error rate in excess of 90 percent. We tried several tricks such as enlarging the microfilm and changing the contrast with no success. In most cases, scanned microfilm text can easily be read by a human; the problem is in the software rather than in the hardware. This would suggest that while current OCR software cannot handle historical microfilmed documents, this may be possible in the future. Much more advanced and expensive OCR equipment is also available; such technology might be able to handle microfilmed text. At present, inexpensive equipment definitely cannot.

[41] We are currently processing a magnetic tape with the complete reports of the German-language *Deutsche Presse-Agentur* (DPA, German Press Agency) for three months in 1991. In theory, *DPA* is a comprehensive international source comparable to Reuters and should have similar coverage but we expect that *DPA* will actually have much denser coverage than Reuters in Central Europe and possibly some other areas such as Latin America and southern Africa. Another source that is readily available in machine-readable form is *Agence France Presse*, which has separate reports in English, French, Spanish and Arabic.

[42] Gaddis may also be overestimating the influence that behavioralist methods have had on policy making and forecasting. Laurance (1990) documents the failures of the event data approach in this regard; O'Neill (1992) does the same for game theory; Cooper (1978) for simulation; Herspring (1992) for behavioralist approaches generally. The behavioralist enterprise has paid little attention to policy-relevant forecasting in part because no one was listening, particularly when compared to the influence of the "slow journalism" approach of traditional foreign policy analysis. In this sense it did not fail so much as it was never seriously attempted.

# REFERENCES

ALKER, H. (1988) "Emancipatory Empiricism:  Toward the Renewal of Empirical Peace Research." In *Peace Research: Achievements and Challenges.*  edited by P. Wallensteen, pp. 219-241. Boulder, CO:  Westview Press.

ALVARADO, S. J. (1990) *Understanding Editorial Text: A Computer Model of Argument Comprehension.*  Boston:  Kluwer Academic Publishers.

ANDRIOLE, S. J., AND G. W. HOPPLE (1984) The Rise and Fall of Events Data: From Basic Research to Applied Use in the U.S. Department of Defense.  *International Interactions* 11:293-309.

ASHLEY, R. K. (1980) *The Political Economy of War and Peace.*  London:  Frances Pinter.

AZAR, E. E. (1980) The Conflict and Peace Data Bank (COPDAB) Project.  *Journal of Conflict Resolution* 24:143-152.

AZAR, E. E. (1982) *The Codebook of the Conflict and Peace Data Bank  (COPDAB).*  Photocopy. College Park:  Center for International Development, University of Maryland.

AZAR, E. E., AND J. BEN-DAK (1975) *Theory and Practice of Events Research.*  New York: Gordon and Breach.

AZAR, E. E., R. A. BRODY, AND C. A. MCCLELLAND, eds. (1972) *International Events Interaction Analysis: Some Research Considerations.*  Beverly Hills:  Sage Publications.

BROCKETT, C. D. (1992)  Measuring Political Violence and Land Inequality in Central America.  *American Political Science Review* 86:169-176.

BURGESS, P. M., AND R. W. LAWTON (1972) *Indicators of International Behavior: An Assessment of Events Data Research.*  Beverly Hills:  Sage Publications.

CIMBALA, S. (1987) *Artificial Intelligence and National Security.*  Lexington, MA:  Lexington Books.

COOPER, C. L. (1978) "Micawber versus de Jouvenel:  Planning and Forecasting in the Real World of Washington."  In *Forecasting in International Relations*, edited by N. Choucri and T. W. Robinson, pp. 338-351. San Francisco:  Freeman.

DALY, J. A., AND S. J. ANDRIOLE (1980) The Use of Events/Interaction Research by the Intelligence Community.  *Policy Sciences* 12:215-236.

DAVIES, J. L. (1991) *The Global Event-Data System: Coders' Manual.*  Photocopy. College Park: Center for International Development and Conflict Management, University of Maryland.

DAVIES, J. L., AND C. K. MCDANIEL (1993) "The Global Event-Data System."  In *International Event-Data Developments: DDIR Phase II*, edited by R. L. Merritt, R. G. Muncaster, and D. A. Zinnes, pp. 19-44.  Ann Arbor: University of Michigan Press.

DAVIS, S. G.  1993.  Using Expert Systems to Predict Foreign Policy Behavior:  The Carter Administration and the Iran Hostage Crisis.  Presented at the meeting of the Midwest Political Science Association, Chicago.

DORAN, C. F., R. E. PENDLEY, AND G. E. ANTUNES (1973)  A Test of Cross-National Event Reliability.  *International Studies Quarterly* 17(2): 175-203.

GADDIS, J. L. (1992/93) International Relations Theory and the End of the Cold War.  *International Security* 17:5-58.

GERNER, D. J. (1991) "Foreign Policy Analysis:  Renaissance, Routine, or Rubbish?" In *Political Science:  Looking To The Future*, Vol. 2.  *Comparative Politics, Policy, and International Relations*, edited by W. Crotty, pp. 123-185.  Evanston, Illinois:  Northwestern University Press.

GERNER, D. J. (1993) Foreign Policy Interactions in the Middle East, 1982-1992: An Event Data Analysis. Paper presented at the meeting of the International Studies Association, Acapulco, Mexico.

GERNER, D. J., P. A. SCHRODT, R. A. FRANCISCO, AND J. L. WEDDLE (1992) Issues in the Creation of Event Data: Machine Coding of Regional and International Sources. Paper presented at the meeting of the American Political Science Association, Chicago.

GOLDSTEIN, J. S. (1992) A Conflict-Cooperation Scale for WEIS Events Data. *Journal of Conflict Resolution* 36: 369-385.

GOLDSTEIN, J. S., AND J. R. FREEMAN (1990) *Three-Way Street: Strategic Reciprocity in World Politics*. Chicago: University of Chicago Press.

GURR, T. R. (1974) *Civil Strife Events, 1955-1970*. (ICPSR 7531). Ann Arbor: Inter-University Consortium for Political and Social Research.

HALL, E. T., AND M. R. Hall (1987) *Hidden Differences: Doing Business with the Japanese*. New York: Anchor/Doubleday.

HALL. S. S. (1992) How Technique is Changing Science. *Science* 257:344-349.

HERMANN, C., M. A. EAST, M. G. HERMANN, B. G. SALMORE, AND S. A. SALMORE (1973) *CREON: A Foreign Events Data Set*. Beverly Hills: Sage.

HERSPRING, D. R. (1992) Practitioners and Political Scientists. *PS* 25: 554-558.

HOPPLE, G. W., S. J. ANDRIOLE, AND A. FREEDY, eds. (1984) *National Security Crisis Forecasting and Management*. Boulder: Westview Press.

HOWELL, L. D. (1983) A Comparative Study of the WEIS and COPDAB Data Sets. *International Studies Quarterly* 27:149-159.

HOWELL, L. D., S. GROVES, E. MORITA, AND J. MULLEN (1986) Changing Priorities: Putting the Data back into Event Data Analysis. Paper presented at the meeting of the International Studies Association, Anaheim, California.

HUDSON, V., ed. (1991) *Artificial Intelligence and International Politics*. Boulder: Westview Press.

JERVIS, R. (1976) *Perception and Misperception in International Politics*. Princeton: Princeton University Press.

JOSHI, A. K. (1991) Natural Language Processing. *Science* 253: 1242-1249.

KHONG, Y. F. (1992) *Analogies at War: Korea, Munich, Dien Bien Phu, and the Vietnam Decisions of 1965*. Princeton: Princeton University Press.

KOLODNER, J. L. (1984) *Retrieval and Organizational Strategies in Conceptual Memory: A Computer Model*. Hillsdale, NJ: Lawrence Erlbaum.

LAURANCE, E. J. (1990) Events Data and Policy Analysis. *Policy Sciences* 23:111-132.

LEBOW, R. N. (1981) *Between Peace and War: The Nature of International Crises*. Baltimore: Johns Hopkins University Press.

LEHNERT, W. AND B. SUNDHEIM (1991) A Performance Evaluation of Text Analysis. *AI Magazine* 12:81-94.

LENG, R. J. (1987) *Behavioral Correlates of War, 1816-1975*. (ICPSR 8606). Ann Arbor: Inter-University Consortium for Political and Social Research.

MARLIN-BENNET, R., AND J. C. ROBERTS (1993) Using Events Data to Identify International Processes: A New Unit of Analysis for International Relations. *International Studies Notes* 18:1-8.

MCCLELLAND, C. A. (1967) Event-Interaction Analysis in the Setting of Quantitative International Relations Research. Photocopy. Los Angeles: Department of Political Science, University of Southern California.

MCCLELLAND, C. A. (1970) Some Effects on Theory from the International Event Analysis Movement. Photocopy. Los Angeles: Department of Political Science, University of Southern California.

MCCLELLAND, C. A. (1976) *World Event/Interaction Survey Codebook*. (ICPSR 5211). Ann Arbor: Inter-University Consortium for Political and Social Research.

MCCLELLAND, C. A. (1983) Let the User Beware. *International Studies Quarterly* 27:169-177.

MCGOWAN, P., H. STARR, G. HOWER, R. L. MERRITT, AND D. A. ZINNES (1988) International Data as a National Resource. *International Interactions* 14:101-113.

MERRITT, R. L.(1987) Event Data: A Synoptic View. Paper presented at the DDIR Conference on Event Data, Ohio State University, Columbus.

MERRITT, R. L., R. G. MUNCASTER, AND D. A. ZINNES (1993) "Event Data and DDIR." In *International Event-Data Developments: DDIR Phase II*, edited by R. L. Merritt, R. G. Muncaster, and D. A. Zinnes, pp. 1-18. Ann Arbor: University of Michigan Press.

MOST, B. A., AND H. STARR (1989) *Inquiry, Logic and International Politics*. Columbia: University of South Carolina Press.

MULLER, E. R., M. A. SELIGSON, H. FU, AND M. MIDLARSKY (1989) Inequality and Political Violence. *American Political Science Review* 83:577-595.

MUNTON, D. (1978) *Measuring International Behavior: Public Sources, Events and Validity*. Dalhousie University: Centre for Foreign Policy Studies.

O'NEILL, B. (1992) A Survey of Game Theory Models on Peace and War. Presented at the meeting of the American Political Science Association, Chicago.

OSGOOD, C. (1971) Exploration in Semantic Space: A Personal Diary. *Journal of Social Issues* 27:5-64.

PAZZANI, M. (1988) *Learning Causal Relationships: An Integration of Empirical and Explanation-Based Learning Methods*. Ph.D. diss., University of California, Los Angeles.

PETERSON, S. (1975) "Research on Research: Events Data Studies, 1961-1972." In *Sage International Yearbook on Foreign Policy Studies* 3, edited by P. J. McGowan, pp. 263-309. Beverly Hills: Sage.

POOL, I. (1970) *The Prestige Press: A Comparative Study of Political Symbols*. Cambridge: M.I.T. Press.

RUMMEL, R. J. (1972) *Foreign Conflict Behavior, 1950-68*. (ICPSR 5214). Ann Arbor: Inter-University Consortium for Political and Social Research.

SALTON, G. (1989) *Automatic Text Processing*. Reading, Mass: Addison-Wesley.

SCHANK, R.C., AND R. ABELSON (1977) *Scripts, Plans, Goals and Understanding*. Hillsdale, NJ: Lawrence Erlbaum.

SCHRODT, P. A. (1993) "Machine Coding of Event Data" In *International Event-Data Developments: DDIR Phase II*, edited by R. L. Merritt, R. G. Muncaster, and D. A. Zinnes, pp. 125-148. Ann Arbor: University of Michigan Press.

SCHRODT, P. A. (forthcoming) "Event Data in Foreign Policy Analysis" In *Foreign Policy Analysis: Continuity and Change in its Second Generation*, edited by L. Neack, J. A. K. Hey, and P. J. Haney.  Englewood Cliffs, New Jersey:  Prentice-Hall.

SCHRODT, P. A., AND D. J. GERNER (1994)  Validity Assessment of a Machine-Coded Event Data Set for the Middle East, 1982-1992.  *American Journal of Political Science* 38.

SCHRODT, P. A., S. G. DAVIS, AND J. L. WEDDLE (1993) KEDS:  A Program for the Machine Coding of International Event Data.  Photocopy.  Lawrence:  Department of Political Science, University of Kansas.

SINGER, E. AND V. M. HUDSON, eds. (1992) *Political Psychology and Foreign Policy*.  Boulder:  Westview Press.

SUNDHEIM, B., ed. (1991) *Proceedings of the Third Message Understanding Conference*.  San Mateo, CA:  Morgan Kaufmann.

SYLVAN, D. A., AND S. CHAN (1984) *Foreign Policy Decision Making: Perception, Cognition and Artificial Intelligence*.  New York:  Praeger.

TAYLOR, C. L., AND D. A. JODICE (1983). *World Handbook of Political and Social Indicators*.  3d ed.  New Haven: Yale University Press.

TOMLINSON, R. G. (1993) World Event/Interaction Survey (WEIS) Coding Manual (6th Revision, draft).  Photocopy.  Annapolis:  Department of Political Science, United States Naval Academy.

VERTZBERGER, Y. Y. I. (1990) *The World in Their Minds: Information Processing, Cognition and Perception in Foreign Policy Decision Making*.  Stanford: Stanford University Press.

VINCENT, J. E. (1983) WEIS vs. COPDAB:  Correspondence Problems.  *International Studies Quarterly* 27:160-169.

WEBER, R. P. (1990)  *Basic Content Analysis*, 2d ed.  Newbury Park, CA:  Sage Publications.

[UNITED STATES] ARMS CONTROL AND DISARMAMENT AGENCY [ACDA] (1989) *World Military Expenditures and Arms Transfers 1988*.  Washington: U.S. Government Printing Office.

CACI, INC.-FEDERAL (1979) *U.S. and U.S.S.R. Crises Data*.  Ann Arbor:  Inter-University Consortium for Political and Social Research.

INTER-UNIVERSITY CONSORTIUM FOR POLITICAL AND SOCIAL RESEARCH [ICPSR] (1991) *Guide to Resources and Services 1991-1992*.  Ann Arbor:  Inter-University Consortium for Political and Social Research.