The expert system for peacefare: A new approach to peace and conflict research

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The expert system for peacefare was developed for predicting and evaluating crises on the basis of psychological theories (power theory, social identity theory) and possibility theory. In a first step 49 conflicts from 1950-1990 of three representative nations (Great Britain, USA and former USSR) were rated by four historians on their typicality of five specific conflict categories (civil war, religious war, war, international conflict and peace). Then 12 trained translators analyzed 187 articles from newspapers and magazines, which were published one week before the conflict began with scales from power theory (Winter) and the social identity theory (Tajfel & Turner, 1986). The inferential engine of the expert system is built upon the theory of fuzzy sets and tries to predict the conflicts from the underlying themes found in the journal articles. Conflicts from 1980-1990 were used to validate the expert-system. 87.5 percent of the American, 62.5 percent of the British and 70 percent of the Russian conflicts could be predicted correctly.

In the era around World War II social psychologists and sociologists were very interested in the field of social conflict and war. Since then many theories have been developed for conflict resolution, mediation and intervention (Rubin, Pruitt & Kim, 1994). The research findings show a variety of psychological techniques predicting (inter-)national tensions and conflicts. Psychohistory (DeMause, 1982; Puhar, 1992), power theory (McClelland, 1975; Winter, 1993), and social identity theory (Tajfel & Turner, 1986; Wagner, 1994) are valid theories dealing with conflict resolution. Even before the Bosnian conflict psychologists warned of the on-going brutality (e. g. Puhar, 1992). But the politicians ignored these warnings from the scientific community and reacted astonishingly blithely. This behavior illustrates that psychological intervention should be better integrated into governmental institutions and set to a higher standard.

One of the forthcoming and most noticed research fields in cognitive science is artificial intelligence. As far back as 1986 Trappl demanded that artificial intelligence (AI) should be used to reduce international tensions. He suggested three potential approaches for AI. An intercul-

tural knowledge base represents the knowledge of different nations, an English-Russian/Russian-English translator program should make the translation and understanding easier and a crises handling expert system should explain the reasons of conflict and predict international tensions. "The development of a crises handling expert system, in contrast to military applications ..., is not aimed at winning a war but at avoiding it "(Trappl, 1986, p. 101). These three suggested approaches have common characteristics: They should make peaceful use of AI techniques, it should be able to execute them on different computer systems and they should be developed by scientists from various nations.

The aim of our study was to develop an expert system for peacefare that should predict war and internal crises. The purpose of this expert system is to support the peacekeeping process (Olbrich & Hergovich, 1996; Olbrich, Hergovich & Herkner, 1996). The political psychologists should use this tool for successful argumentation in the political decision making process. As possible predictors for our expert system we considered two theories: the power theory and the theory of social identity.

Power theory

Power theory (McClelland, 1975; Winter, 1993) is one of the major theories for predicting war and other conflict states. McClelland (1975) postulated and tested several hypotheses on power, affiliation, and achievement

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motives. People who are on a high level of power motive are concerned about having impact on other people. They seek and get formal social power. On the other hand people with a high level of affiliation motive need and seek warm and close relationships. A high achievement motive is expressed by managers and teachers.

McClelland (1975) applied motivation measures to cultural documents (e.g. fairy tales, popular fiction, diaries, etc.) and estimated motive levels of groups and nations. In two studies of British history from 1550 through 1800 and of the history of the United States from 1780-1969 he found the same motive constellation in both countries before war. A high level of power motive and a low level of affiliation motive preceded war. Although both studies involved a macrohistoric focus - the unit of measurement in the British history was a half century and in the U.S.-study a decade - the motive constellation is supported by other studies (Winter,1993) with smaller units (days and weeks).

When both power and affiliation motives are on high levels, religious or secular crusades will follow after a lag of 10 to 20 years (McClelland, 1975). This constellation means that different groups desire to have impact on each other and have also a deep concern with others' welfare. The groups tend to reform civil rights and the social system. McClelland suggested that low affiliation and power lead to peace, which lasts until power rises again.

In 1993 Winter tested McClelland's power theory on the history of Great Britain (1602-1988), the Cuban Missile Crisis (October, 1962), and the outbreak of World War I (1914). He analysed the Sovereign's Speeches and found the postulated motive constellation one year before Great Britain entered war. The analysis of the Cuban Missile Crisis showed a decrease in the difference between power and affiliation motive, i. e. the power minus affiliation score significantly decreased from the first half of the American and Soviet government-to-government communication to the second half. Before World War I the opposite motive changes were found: the power minus affiliation score increased. Winter (1993) analysed the British and German government-to-government exchanges of the last 12 days before the outbreak. In this case the increase of power and affiliation motive difference was also statistically significant. Winter's study supports power theory and the hypothesis that a prediction of war and peace is possible based on the dynamics of power and affiliation motives.

Social identity theory

The second psychological theory which has been shown to have solid predictive strength in anticipating and predicting conflicts is the social identity theory (Tajfel &

Turner, 1986; Wagner, 1994). Social identity consists of those aspects of an individual's self image that derive from social categories to which he perceives himself as belonging. Persons strive to achieve positive social identity. Positive social identity is based on group-comparisons. The individuals perceive their own group (in-group) distinctive from relevant out-groups and evaluate the in-group more positively. When their social identity is unsatisfactory, people tend to leave their group and join some more positively perceived group or try to make their own group more positively distinct. "The basic hypothesis, then, is that pressures to evaluate one's own group positively through in-group/out-group comparisons lead social groups to attempt to differentiate themselves from each other." (Tajfel & Turner, 1986, p.16).

Social categorizations systematize the social world and provide a system of orientation for self reference. A group exists when two or more people define themselves as members of it and when its existence is recognized by at least one other (Brown, 1988). This definition of groups is a sufficient explanation for social identity theory (Turner, 1982). The salience of the in-group determines the social identity. It depends on the accessibility of the groupcategory in memory and the stimulus fit (Turner et al., 1987).

Wagner (1994) postulated that conflicts ought to make membership in a group more salient. During inter-group conflicts the members of each group perceive the own ingroup as homogenous. This homogeneity is mainly expressed through the media. No opposition within the ingroup is supposed to be mentioned during the initial stage of a crisis. Another fact that have been postulated by Wagner (1994) was that the in-group leader would be evaluated positively by the in-group and media. Group leaders often tend to compete with other groups when their position in their in-groups is threatened by internal crises (Rabbie & Beckers, 1976). In this situation intergroup competition makes the social identity for the ingroup salient and strengthens the position of the leader. Wagner (1994) mentions that leaders may also behave unconsciously and that they rationalize their decisions.

The two theories (power theory and social identity theory) were valid predictors for crises in recent studies (e.g. Winter, 1993; Wagner, 1994). Thus we also decided to include measures of the power motive and variables which were elaborated by researchers in the field of social identity. In our study we attempted to develop an expert system which on the one hand is able to determine if in the near future (one week later) a conflict breaks out, and on the other hand, it should identify the type of the occuring crisis. We supposed that the tensions between (or within) nations can be found in mass media (Olbrich & Hergovich, 1996; Olbrich, Hergovich & Herkner, 1996). In particular, it should be likely that when a conflict arises the

power motive, salience of group membership or evaluation of outgroup and ingroup differ from these measures in periods of peace. To examine this hypothesis, participants had to analyze articles from three representative nations (USA, former USSR and Great Britain). Four cooperative historians classified the conflicts (or decided that the event could be considered as peace) which emerged one week after the articles where published. The inference engine of the expert system which was programmed in Visual Basic 3.0 is based on fuzzy set theory (Klir & Folger, 1988) and connects the data (scores of the social identity and power motive scales) with the classification of the historians. Based on these results the expert system should be able to identify also conflicts without any previous classification, i.e. the expert system should be one big step ahead of the historians.

METHOD

The design of the expert system for peacefare

Expert systems emulate reasoning processes of human experts within a specific domain. These computer programs make the experience and problem solving capabilities of experts available to nonexperts. Every expert system contains a knowledge acquisition module, a database, an inference engine and an explanatory interface. The database contains cases or examples of the specific domain. The data are supplied to the inference engine, which evaluates relevant production rules and draws all possible conclusions. The explanatory interface presents the result in a simple, understandable way. New data are put into the database via the knowledge acquisition module.

Expert systems have proved to be very useful tools. The most famous application is MYCIN, a program for diagnosis and therapy selection in the case of infectious diseases (Buchanan & Shortcliffe, 1984). This system is rule-based. Rules are of the general structure "if (condition) then (action)". The conditions may consist of several sub-conditions. In MYCIN the rules contain the knowledge and define how the inference engine functions. In the past two decades in addition to rule-based expert systems two other programming paradigms for expert systems have emerged. The connectionistic paradigm uses neural networks for reasoning (Rumelhart & McClelland, 1986) and the third and most forthcoming paradigm applies fuzzy logic to the inference engine (Ezhkova, 1992; Klir & Folger, 1988; Klir & Yuan, 1995). These two paradigms use special cases or examples for computation. The rules of these systems are generated by the data themselves and are not explicitly designed as they are in MY-CIN. The advantage of these paradigms is the ability to learn new rules from the data.

Design of the database

Fourty-nine conflicts for three nations (Great Britain, USA, former U.S.S.R) from 1950 - 1988 were chosen from the chapter "Chronology of Major Dates in History" in Webster's Encyclopedic Unabridged Dictionary of the English Language, 1993 (see Appendix for description). These 49 conflicts were rated by four historians from the University of Vienna, according to their possibility (typicality) of war, civil war, religious war, international conflict and peace on scales from 0 to 1. The results are presented in table 1.

After this historical classification 187 articles out of representative newspapers and magazines (*Economist*, Guardian, The Daily Telegraph, The Times, Newsweek, Time, The New York Times, Pravda and Isvestija) which were published one week before each conflict began were rated by 12 trained students and translators on scales of power theory with the running text scoring system for motive imagery (RTSS) and the social identity theory.

Table 1
Classification of the 49 Conflicts by 4 Historians

	Bolognese	Feldbauer	Sieder	Anonymous
Civil War				
Great Britain	4	4	4	3
USA	3	2	3	1
USSR	0	2	0	2
International Conflict				
Great Britain	6	5	7	6
USA	10	11	10	11
USSR	9	10	7	4
War				
Great Britain	5	2	1	5
USA	6	3	3	6
USSR	4	4	0	3
Religious War				
Great Britain	3	0	3	3
USA	1	0	2	0
USSR	0	2	0	0
Peace				
Great Britain	1	8	0	5
USA	6	6	2	4
USSR	3	5	5	0

Note. Fourtynine conflicts were rated by 4 historians on their typicality of civil war, international conflict, war, religious war and peace on scales from 0 to 1. The number of conflicts with possibility > .5 are presented (multiple response was possible).

Measures

The running text scoring system (RTSS)

Winter (1991, 1994) developed a running text scoring system for motive imagery (RTSS) which is used to score any verbal material (e.g. speeches, letters, documents, articles, etc.). The RTSS measures power, affiliation and achievement motives. The power motive is defined as "any indication that one person, group, institution, country, or other person-like entity has an impact, control or influence on another person, group, institution, country, or the world at large" (Winter, 1994, p. 15). The affiliation motive is expressed by terms or "any indication of establishing, maintaining or restoring friendship or friendly relations among persons, groups, nations and so forth. Mere connection, association, or even common activities are not enough; there must also be a warm, friendly quality about the relationship" (p. 12) and "any indication of a standard of excellence" (p. 8) is scored as achievement motive (see Table 2). The reliability of the RTSS is r = .61 (Winter & Stuart, 1977). Persons with no previous motive scoring experience learn to score in about 15 hours and achieve reliability of category agreement with expert scoring above r = .85 (Winter, 1994).

Social identity scale

For analyzing articles from newspapers and magazines we developed a social identity scale (see Wagner, 1994). The social identity scale consists of the following 5 items:

- 1. Is any membership to a group mentioned?
- 2. How positive/negative is the evaluation of the own group?
- 3. How positive/negative is the evaluation of the own leader?
- 4. How positive/negative is the evaluation of the other group?
- 5. How positive/negative is the evaluation of the other leader?

Scores on each item could range from 0 to 50, for the trained raters had to answer the items by marking a bar 5 cm long. The distance from the beginning of the bar to the marking was measured and this value (in mm) gave us the corresponding score.

The reliability (Cronbach's alpha) of this scale varies between r = .61 for British data (newspapers) and r = .49 for U.S data (newspapers). For the power of the items see Table 3.

Table 2 Some Examples of Motive Imagery

Power motive:

- "..to wipe them out"
- "...take strong, forceful actions"
- "The government has used unemployment to fight inflation"

Affiliation motive:

- "...to be in love with"
- "..to strenghten positive relationship"
- "He felt very sad"

Achievement motive:

- "...quality of performance"
- "The president wanted to find a better solution"
- "Our investigations are advanced and set a high standard"

Table 3
Power of social identity items

Salience	.4756
Evaluation In-group	.6360
Evaluation In-group leader	.5469
Evaluation Out-group	.1588
Evaluation Out-group leader	.0813
USA data Salience	.4270
Evaluation In-group	.3566
Evaluation In-group leader	.4529
Evaluation Out-group	.0607
Evaluation Out-group leader	.0565

The inference engine

The historical classification and the scores of the 187 articles were stored in two separate ASCII-files, which are used by the inference engine to draw all possible conclusions and compute the possibility functions. The main idea for using ASCII-files was Trappl's postulate that data for peacefare should be portable to any computer system (Trappl, 1986). New data are added into the database via the two knowledge acquisition modules. The first acquisition module inserts the new analysis of articles; the second, new historical classifications to the database (see Figure 1 and 2).

The inference engine of our expert system for peacefare is based on fuzzy set theory (Klir & Folger, 1988; Klir & Yuan. 1995). Conventional set theory assigns a value of either 1 or 0 to each individual in the set, thereby discriminating between members and nonmembers of a set. This dichotomous discrimination is not applicable to human inference behavior (Parikh, 1977). Fuzzy set theory assigns values to the elements in the unit interval [0,1]. The function, which represents this process, is called membership function. The higher the value of a specific element the greater the typicality of this specific element for this set. The operations of conventional set theory (intersection, union, complement, etc.) are also used in fuzzy set theory, although they are generalized in some respects (Dubois & Prade, 1980).

The inference engine of the expert system computes the membership functions out of the data: The data (scores of the social identity scales and the running text scoring system (RTSS)) are connected to the evaluation of the conflicts by the four historians. The articles on the same conflict are assigned the same possibility (i. e. the specific values of the psychological scales were assigned membership to the sets of the five conflict types). For each scale there exist five possibility functions. Figure 3 illustrates the possibility functions of the achievement motive for the US-conflicts rated by the historian Sieder. E.g. a mean value of 4 (each article was analyzed by at least two raters) indicates peace. (Sieder rated all conflicts of the USA. From all conflicts which have the specific value 4 in the achievement motive, the possibility for peace is the highest. On the other hand a value of 6 indicates international conflict.)

The inference engine compares the resulting possibility (i. e. membership) functions for each conflict type with new data and decides which function matches best. For each scale the five possibilities are predicted. Then the

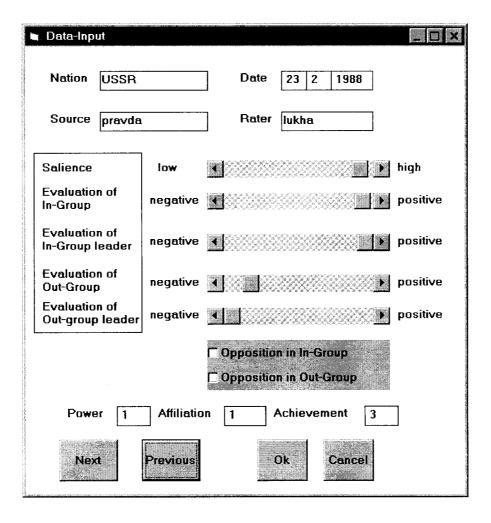


Figure 1. The Data Input Window

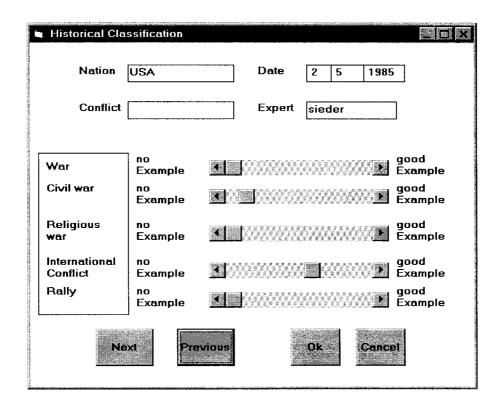


Figure 2. The Input Window for Historical Classification

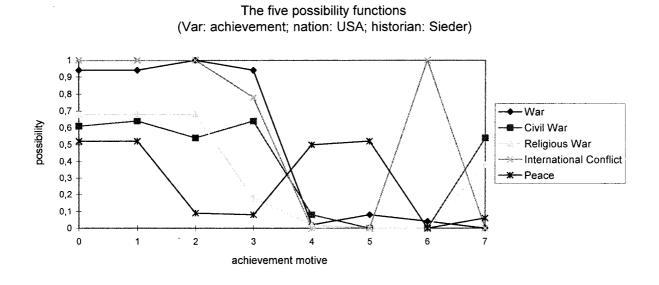


Figure 3. The five possibility functions for an item

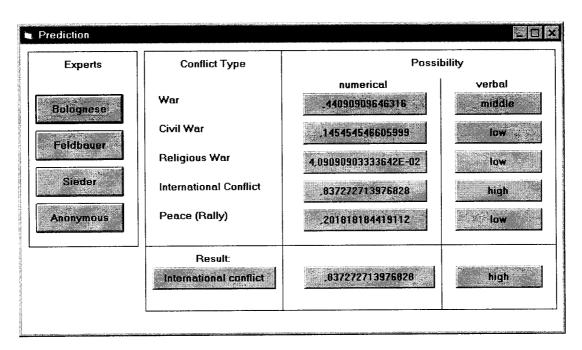


Figure 4. The inference engine

	numerical possibility	verbal possibility
Salience	51	middle
Evaluation of In-Group	.96	high 4
Evaluation of In-Group leader		low
Evaluation of Out-Group	. 	high
Evaluation of Out-Group leader	36	high
Opposition in In-Group		high
Opposition in Out-Group	24.94 V	high
Power	96	high
Affiliation	.96	high
Achievement		high
Power-affiliation	.96	high

Figure 5. Conflict type - possibilities for each scale

The inference engine compares the resulting possibility (i. e. membership) functions for each conflict type with new data and decides which function matches best. For each scale the five possibilites are predicted. Then the inference engine computes the average possibility for each of the five conflict types over all scales. Finally the greatest predicted possibility of one of the five conflict types is the result of the inference process. The prediction of the possibility functions of each conflict type for a new historical event is computed separately for any of the four historians, who classified the basic 49 conflicts of the database (see Figure 4).

The inference engine is embedded in the explanatory interface. The explanatory interface visualizes the results of the computation in numerical and verbal form for each conflict type and presents the best matching function. The computed conflict type-possibilities for each scale are presented in a separate window and are interpreted verbally. In Figure 5 the possibilities for international conflict are presented. The predicted possibilities for the conflict type-international conflict in 9 of 11 variables are high. The analyzed conflict has only one low possibility (evaluation of in-group leader). According to Figure 4 the analyzed conflict should be classified as international conflict.

Evaluation and Validation

For a first validation of the expert system for peacefare we analyzed 30 articles from the 1980's, which were cut from the database. The expert system was fed with the scores of the RTSS and the scale for social identity from these articles. The resulting possibilities were compared with the classifications by the four historians. The results indicate very good validity for the USA (on the average 87.5% of the articles were correctly classified). After the binomial distribution the probability, that 8.7 of 10 articles are correctly classified by chance is p < 0.000 (under the assumption, that all classifications are independent, for 8.7 correctly classified articles and the a priori probability of 0.2 (for there are five conflict types given) to classify each conflict correctly by chance). Table 4 shows the results and the significances of the classification process for each historian. Significant results also occured for the U.S.S.R. (on the average 70% of the classifications were correct, p < .001). For Great Britain the results are modest, on the average only 37.5% of the articles were classified correctly (p = .201). The validation failed only on the basis of Sieder's and Anonymous' classification (see Table 4).

Table 4
Validity of the Expert System for Peacefare based on the historical classification of four historians

Correct classification for all conflict types:

Nation	Bolognese	Feldbauer	Sieder	Anonymous
USA (n = 10)	60% ***	90% ***	100% ***	100% ***
USSR $(n = 10)$	80% ***	80% ***	70% ***	50% **
Great Britain $(n = 10)$	40% *	50% **	30%	30%

- * p < 0.10
- ** p < 0.05
- *** p < 0.01

CONCLUSION

It seems that the expert system for peacefare is a valid tool for predicting international and national conflicts. It is based on the psychological theories of power (McClelland, 1975; Winter, 1993) and social identity (Tajfel & Turner, 1986; Wagner, 1994). As McClelland found the constellation of power, affiliation and achievement motive are successful variables to identify the conflict types we investigated in our study (peace, international conflict, religious war, civil war and war). Moreover, it could be demonstrated that the evaluation of inand outgroup as well as the salience of membership are important predictors for conflicts. The scales (RTSS and social identity scale) we used are sufficiently reliable and easy to learn for psychologists and students. The computer program runs under Windows 3.1 and higher and the database is built upon two ASCII-files, which are portable to most computer systems in the world. Thus the expert system fulfills Trappl's (1986) main stipulations. Although our first results are encouraging, further research will be necessary to expand the database and to consider other nations and also to take into account other theories for explaining conflicts. A main issue in the future will also be to differentiate between war and peace (i.e. detecting predictors for conflict is not enough, we must also find stable predictors for peace).

The expert system for peacefare should stimulate a successful argumentation in political decision making and encourage peace-keeping processes. Perhaps the day will come when political psychologists working in the area of political decision making or mediation can use such a tool. Finally, we think that our expert system could be applied to make democratic processes for conflict resolution easier to implement.

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APPENDIX

The 49 conflicts of the database chosen from the Chronology of Major Dates in History from Webster's Encyclopedic Unabridged Dictionary of the English Language, 1993

Year	Event
Great Britain:	
1954	British occupation of the Suez Canal zone is scheduled to end within 20 months
1966	U.K. imposes complete ban on trade with Rhodesia
1969	Riots in Northern Ireland; the "Troubles" begin
1971	The first British soldier is killed in Northern Ireland
1972	Westminster takes over direct rule of Northern Ireland, abolishing the regional government ("Stormont")
1980	Race riots in Bristol, England
1980	Terrorists seize Iranian embassy in London; Special Air Service troops storm embassy and free hostages.
1981	Race riots in Brixton, South London, injure 114 police and 192 civilians
1981	Violent race riots in Toxteth district of Liverpool
1982	Argentina invades the Falkland Islands, the Falkland war begins
1984	A gunman firing from the Lybian People's Bureau in St. James's Square, London, murders Police Constable Yvonne Fletcher; the U. K. government severs diplomatic relations with Lybia.
1985	Race riots in Handsworth section of Birmingham,
1985	U.K. government expels 25 Soviets named by Soviet defector Oleg Gordievsky as KGB officers
1985	Race riots in Brixton, South London.

United States of America:

1950	The Korean war breaks out when North Korea invades South Korea. The U.N. Security Council asks members to help the Republic of South Korea; the United States agrees to send troops.
1960	U.S Negroes hold "sit-ins" in southern states protesting against lunch-counter segregation.
1960	The U-2 high-altitude jet reconnaissance plane flown by U.S. civilian Francis Gary Powers is shot down over the U.S.S.R.
1962	U.S. establishes Military Assistance Command in South Vietnam
1962	President Kennedy announces U.S.S.R has missile bases in Cuba, threatens nuclear war with Soviet Union, and demands removal of weapons, to which Premier Khrushchev agrees, leading to end of missile crisis.
1963	Mass Civil Rights rally in Washington D. C.
1964	Panamanians riot against U.S. troops in Canal Zone. Panama severs relations with U.S.
1964	Negroes riot in New York City. Violence spreads to other major cities in northern U.S.
1965	Dominican military officers favoring the return of Juan Bosch overthrow U.Sbacked junta. U.S. Marines land, followed shortly by U.S. paratroopers as fighting continues between pro- and anti-Bosch forces. O.A.S. sends troops to maintain order and U.S. forces withdraw.
1965	First large-scale U.S. Army ground units arrive in South Vietnam.
1965	Negroes riot for six days in Watts section of Los Angeles
1966	Race riots in Chicago, Illinois
1966	Race riots in San Francisco, California
1967	Race riots in Detroit, Michigan; 36 killed
1968	James Earl Ray assassinates Dr. Martin Luther King, Jr., in Memphis, Tennesse

(Continued on the next page)

1970 U.S. and South Vietnamese incursion into Cambodia Mobs in Iran storm U.S. embassy, holding ambassador and staff captive for several hours. 1979 Five hundred students ("Revolutionary Guards") seize the U.S. embassy in Teheran and hold its in-1979 habitants hostage for 444 days, with the connivance of the Iranian government of the Ayatollah Khomeini. 1980 Race riots in Miami; 17 die A left-wing coup kills Maurice Bishop of Grenada; U.S. invades Grenada, 8 U.S. marines killed, 100 1983 Cubans killed, 600 Cubans captured. President Reagan imposes economic sanctions against Nicaragua. 1985 U.S. aircraft bomb targets in Lybia after Libya fires missiles at U.S. warships in the Gulf of Sirte. 1986 U.S. bombers raid Tripoli and Benghazi, in attempt to wipe out terrorist bases; 100 deaths, according to 1986 the Libyans, but Qaddafi survives. Former U.S.S.R. The Hungarian uprising, an armed revolt and student demonstrations against the Communist regime in 1956 Hungary. The U-2 high-altitude jet reconnaissance plane flown by U.S. civilian Francis Gary Powers is shot 1960 down over the U.S.S.R. President Kennedy announces U.S.S.R has missile bases in Cuba, threatens nuclear war with Soviet 1962 Union, and demands removal of weapons, to which Premier Khrushchev agrees, leading to end of missile crisis. Sino-Soviet talks in Moscow end in failure and ideological differences, especially Chinese opposition 1963 to Russian policy of peaceful coexistence, are intensified. Chinese students clash with Soviet police in Red Square in Moscow. 1967 Soviet invasion of Czechoslovakia crushes "Prague Spring". 1968 Chinese and Soviet troops clash at Sinkiang, China; heavy casualties 1969 The Soviet Union invades Afghanistan; in Soviet-backed coup, Prime Minister Hafizullah Amin is exe-1979 cuted and is replaced by Babrak Karmal.

U.K. government expels 25 Soviets named by Soviet defector Oleg Gordievsky as KGB officers

Soviet official sources admit 31 killings in race riots in Sumgait Azerbaijan

Students riot in Alma Ata, the capital of Kazakhstan

1985

1986

1988