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Misperceptions and Bargaining in the Persian Gulf Crisis

by

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Hypergame analysis is a methodology developed for modeling and analyzing decision making problems in complicated conflicts, where decision makers may have misunderstandings about each other. In this paper, the Persian Gulf war between Iraq and the U.S.-led Allied forces is modeled as a hypergame, where misperceptions occurred during the evolution of the crisis. In particular, it is highlighted how misperceptions affected the bargaining and negotiations for peaceful resolutions which took place at various critical points in time when the crisis escalated. Moreover, the hypergame stability analysis reveals how misunderstandings influenced the behavior of each decision maker as well as the possible conflict resolutions that the decision maker perceived could take place. Because

the course of a conflict such as the Persian Gulf crisis can be significantly affected by misperceptions, the hypergame methodology provides an important decision support tool in the area of international conflict management.

1. Introduction

Hypergame analysis constitutes a flexible methodology for modeling and analyzing a real world conflict where decision makers do not have the same perceptions about the conflict situation. Misunderstandings may be caused by incomplete information, deception, or ignorance. By using hypergame analysis, the influences of information and misperception in conflict decision making are highlighted, and the possible resolutions to conflicts with misperceptions are predicted (Bennett, 1980; Fraser et al., 1990; Hipel et al., 1988; Okada et al., 1985; Wang et al., 1988a, 1988b, 1989).

In this paper, the Persian Gulf war between Iraq and the U.S.-led Allied forces is modeled and analyzed as hypergames for the situations that existed just before the outbreak of the air war on January 16, 1991, and the ensuing ground war on February 23, 1991. In particular, bargaining and negotiations for peaceful resolutions took place before the crisis escalated into warfare. Twice at the critical points in time, misperceptions significantly affected the course of the crisis. The hypergame analysis for the situation on January 16, 1991, was completed by the authors on January 11 and 12, a few days before the war actually broke out. The purposes of this paper are the present the exact results for the study as completed on January 12, as well as the results for the ground war, and compare these unchanged findings to what eventually took place. As explained later in this paper, the hypergame studies furnished reasonable predictions to what ultimately happened and certainly provided a better understanding of the Persian Gulf crisis.

2. Historical Background

On August 2, 1990, the armed forces of President Saddam Hussein of Iraq launched a sudden and massive invasion into the tiny oil-rich kingdom of Kuwait.

TABLE 1: THE EVOLUTION OF THE PERSIAN GULF CONFLICT

Dates	Events
July 15 1990	Iraq demanded $4.4 billion in compensation for the oil "stolen" by Kuwait, as well as $14 billion in lost oil revenue. Iraq also wanted Kuwait to forgive $15 billion in loans. Meanwhile, President Hussein moved troops towards the Kuwaiti border.
July 18	Kuwait declared a state of emergency.
July 25	U.S. Ambassador April Glaspie told Hussein that the U.S. has no opinion on an Arab border dispute.
Aug, 2	Iraq invaded Kuwait. The UN Security Council adopted resolution 660, calling for the complete and unconditional withdrawal off all Iraqi troops from Kuwait.
Aug. 6	US and Britain started dispatching troops to the Persian Gulf. The UN Security Council imposed an international trading embargo on Iraq.
Aug. 10	The Arab League condemned the invasion and some members sent their troops to Saudi Arabia.
Aug. 15	Iraq accepted all Iranian conditions to reach a formal end to the Iran-Iraq war.
Aug. 28	Kuwait was declared the 19th province of Iraq.
Sept. 28	Soviet President Gorbachev called for Iraq to withdraw from Kuwait.
Nov. 18	U.S. President George Bush doubled the size of the US troop commitment.
Nov. 29	The UN Security Council authorized the use of force against Iraq if Mr. Hussein failed to comply with the UN resolutions by Jan. 15, 1991.
Jan. 9 1991	The American Secretary of State James Baker and the Iraqi Foreign Minister Tariq Aziz met in Geneva for six hours and failed to bridge their differences.
Jan. 14	The UN Secretary-General went to Baghdad for a last minute peace effort.
Jan. 16	The U.S.-led Allied forces of 28 nations launched air strikes against Iraq and occupied Kuwait.
Feb. 12 - 22	Mr. Gorbachev made one last attempt to broker peace between Iraq and the Allies.Iraq appeared as a hard bargainer in the negotiations.
Feb. 22	Mr. Bush gave Iraq an ultimatum demanding unconditional withdrawal from Kuwait by February 23.
Feb. 23	A full scale ground war lasting 100 hours was launched by the Allies against Iraq.
Feb. 27	Mr. Bush announced the liberation of Kuwait and stopped offensive action unilaterally.

After an easy victory over Kuwait, there was a seven month period during which no hostilities took place. However, on January 16, 1991, the American-led Allied forces launched an air war against strategic targets in Iraq and occupied Kuwait. This was followed by a one hundred hour ground war, starting on February 23, 1991, which decimated the Iraqi armed forces.

Even though both the Americans and Iraqis had opportunities to negotiate relatively peaceful settlements to the crisis before both the air and ground wars, misperceptions and lack of communication resulted in hostile military actions taking place. The world watched with amazement as the Persian Gulf crisis jumped from one stage to the next until the Iraqi armed forces were defeated. Moreover, this defeat immediately led to uprisings against Hussein by the suppressed Kurdish people and Shi'ite Muslims living in the north and south of Iraq, respectively, which were brutally crushed by the remaining Iraqi army. There is little doubt that the Iraqi problem will continue to simmer as long as Saddam Hussein remains in power and the economy of Iraq is not restored. Whatever the case, Table 1 provides a summary of the main events of the Persian Gulf crisis from mid-July 1990 until the end of the ground war (MacKenzie, 1991).

2.1. The Evolution of the Crisis

The Persian Gulf war began with the Iraqi invasion of Kuwait on August 2, 1990, which was caused by an oil dispute between the two nations. By the conclusion of the eight year war with Iran, President Hussein had built the fourth largest army in the world and, hence, had become the strong man in the Middle East region. Before the aggression against Kuwait, Mr. Hussein still had \$70 billion (US) in war debts and the \$10-billion-a-year cost of keeping 1 in 17 Iraqi citizens under arms. The nation's income almost entirely relied upon a single commodity, oil, which accounted for 95% of its exports.

Shortly before the invasion, Iraq openly complained about the over – production of oil by Kuwait which, Iraq maintained, had cost Iraq \$14-billion in lost revenue. On July 15, 1990, Iraq demanded \$2.4-billion from Kuwait for oil "stolen" from the Rumailah oil field, which was shared by the two countries. The claim went up to \$4.4-billion two days later. Along with the \$4.4-billion in compensation for the lost oil, Iraq also wanted Kuwait to forgive \$15-billion in loans granted to it by Kuwait during the Iran-Iraq war. Meanwhile, Iraq moved its troops towards the Kuwaiti border, and, consequently, on July 18 Kuwait declared a state of emergency. On July 19, Kuwait cancelled the state of emer-

gency after apparently promising to support efforts to push the price of oil to $20 per barrel. On July 25, U.S. ambassador April Glaspie, summoned to meet Mr. Hussein, told him the United State "has no opinion" on an Arab border dispute. Diplomats reported, mistakenly, that Iraq had agreed to withdraw its troops from the Kuwaiti border. During next two days, OPEC countries met in Geneva amid reports that the dispute between the two countries had been defused. OPEC agreed to a $21-a-barrel price for oil, and Kuwait and the United Arab Emirates agreed to slash production. Iraqi and Kuwaiti diplomats met in Saudi Arabia on July 31 to discuss their dispute over the Rumailah oil field and other Iraqi complaints. The talks collapsed on August 1 , but Egyptian President Hosni Mubarak and Jordan's King Hussein assured U.S. officials that Iraq had assured them it would not use military force. On the next day, August 2, 1991, Iraq invaded Kuwait, easily rolling over the 20,000-man armed forces in a predawn attack. Baghdad said it was responding to an invitation from a revolutionary government in Kuwait (MacKenzie, 1991).

Within days of Iraq's invasion of Kuwait, the UN Security Council quickly adopted resolution 660 of 1990, condemning the invasion, and calling for the complete and unconditional withdrawal of all Iraqi forces from Kuwait. The resolution was later enforced by an international trading embargo and the authorization of the use of force. The U.S. and British wasted no time in dispatching troops to the Persian Gulf, who were soon joined by troops of many other states, including Arab nations.

In spite of strong condemnations from countries throughout the world, Mr. Hussein had no any intention to give up Kuwait. Accordingly, Iraq announced the annexation of Kuwait on August 8, and ordered embassies in Kuwait to close. On August 28, Kuwait was declared the 19th province of Iraq, and Mr. Hussein announced a holy war against U.S. forces. The Iraqi information minister said that Kuwait no longer existed and the world should not agitate for Kuwaiti independence. To force Iraq to withdraw from Kuwait, the American President, Mr. George Bush, doubled the size of his troop commitment on November 18, saying that the new forces were needed to provide "an offensive option". On November 29, the UN Security Council authorized the use of force against Iraq if Mr. Hussein failed to comply with the UN's call for an unconditional withdrawal from Kuwait by January 15, 1991, which was denounced by Iraq as "illegal and invalid". On November 30, the United States offered reciprocal meetings of foreign ministers before January 15.

However, a tentative meeting between Mr. Bush and the Iraqi Foreign Minister Tariq Aziz was cancelled because of a disagreement over the U.S. Secretary of State James Baker's trip to Baghdad. Mr. Aziz and Mr. Baker met in Geneva for six hours on January 9, 1991, and failed to bridge their mutually exclusive positions. Baghdad was sticking to its insistence on linking the gulf crisis with the Palestinian issue, a position Washington would not accept, since it demanded that Iraq unconditionally withdraw its troops from Kuwait. At his visit to Baghdad on January 14, the UN Secretary-General Javier Perez de Cuellar hoped to persuade Saddam that it was in his best interests to leave Kuwait voluntarily. After meeting with Mr. Hussein, he said that there was virtually no chance of a peaceful settlement (Koring and MacKenzie, 1991). Subsequently, on January 16, 1991, a storm of Allied smart bombs rained down on strategic targets in Baghdad and elsewhere in Iraq as well as Kuwait. The 38 day air campaign was followed by a 100 hour ground war, launched on February 23. The Persian Gulf war led to the military defeat and the economic ruin of Iraq.

2.2. Misperceptions in the Persian Gulf Crisis

When the gulf war exploded, both sides were ready for it and they would rather fight than switch their positions. However, this firm readiness was built upon careful calculations, or miscalculations, of various consequences of the conflict. Of prime importance was the fact that Mr. Hussein underestimated the U.S. willingness to fight and overestimated his own military power.

During the Geneva meeting between the American Secretary of State James Baker and Iraqi Foreign Minister Tariq Aziz on January 9, 1991 , Hussein's half brother Barzan Tikriti had sat on Aziz's right, closely scrutinizing the American team. Soon after the session ended, Barzan telephoned Baghdad and informed Hussein that the Americans did not want to flight. If Saddam had believed his relative, he would have seen no urgency in accepting any proposal that left him less than what he started with, which was the whole of Kuwait. It was a fateful misjudgment (Church, 1991a, 1991b).

Mr. Hussein believed until the last moments before the Gulf war started that he could defeat the U.S.. In fact, he told his general staff during a secret visit to occupied Kuwait on Jan. 15, one day before the air campaign began, "The American has built all his calculations on his feeling of technological superiority. All you need is that your weapons and soldiers stay under the ground and this

advantage (air superiority) will be over, (and) he will be struck with frustration. When he is frustrated he will be defeated." (Kitchener-Waterloo Record, 1991).

Hussein's strategic mistakes were also induced by deliberate deceptions by the Allies. On the day the Allied air campaign began on January 16, 1991 , the Allies started to secretly move large numbers of troops and equipment from the Saudi Arabian border with Kuwait in a westerly direction as far as 500 km inland from the gulf. During the ground war, the Iraqis were caught by surprise when these forces outflanked the Iraqi troops stationed in and near Kuwait. Moreover, military deception was also taking place at sea where large American and Allied naval forces appeared to be building up for a coastal invasion of Kuwait. Convinced that the main attacks would come from the front line along the Saudi-Kuwaiti border and from the sea, Hussein concentrated 6 of his 43 divisions along the Kuwaiti coast, and built up solid fortifications along the border areas between Kuwait and Saudi Arabia (MacKenzie, 1991; Nelan, 1991; Waller, 1991).

Due to these misjudgments, Mr. Hussein lured himself into thinking that the U.S. may prevail in the air, but, once the ground war began, the U.S. could not sustain the heavy casualties, just like what happened in Vietnam. Therefore, Mr. Hussein announced an "eternal merger" of Kuwait with Iraq, which left him no leeway to retreat from Kuwait without a serious loss of face. He lost another chance for peace before the ground war started by not acting quickly enough to take advantage of the Soviet peace effort (Primakov, 1991). Mr. Hussein's misperceptions led to an embarrassing military defeat for his army and widespread suffering by the Iraqi people.

3. Hypergame Analysis Before the Air War

3.1. Hypergame Modelling

In this section, the Persian Gulf crisis is modelled and analyzed for the dispute that existed just prior to the outbreak of the air war. The conflict taking place just before the ground war is studied in detail using hypergame analysis in Section 4. As mentioned in the introduction, the hypergame study of this section was completed in real time at a crucial point in the evolution of the conflict - the situation that existed just before the commencement of the air war on January 16, which was followed by the 100 hour ground war on February 23, 1991. Before the coalition began a 38-day aerial assault of Iraqi targets

in Iraq and occupied Kuwait, both sides had to contemplate thoroughly their options, strategies and various possible consequences of the conflict in order to make their decisions. A short version of this hypergame analysis was originally presented by Wang and Hipel (1991), while these same authors give the exact detailed results for their hypergame study here.

Decision Makers and Their Options

As noted in Table 1 , January 15, 1991, is the UN deadline for the unconditional withdrawal of Iraqi forces before possible attacks by the Allies to force them to leave Kuwait. Prior to January 15, there are three options available for the U.S.-led coalition: (1) an air strike on Iraq and occupied Kuwait (air strike); (2) a full scale ground war against Iraq and occupied Kuwait (ground war); (3) negotiations. A subset of these three options forms an Allied strategy. By taking the first two options, for example, the U.S.-led Allied forces take the strategy of air strike and ground war, where the coalition is determined to strongly uphold the UN resolutions and deadline. When selecting a strategy of negotiation only, the Allied forces could offer some kind of compromise, such as an international conference to address the Israeli-Palestinian problem if Iraq withdraws from Kuwait. By choosing this strategy, the Allies are less determined in expelling the Iraqi forces from Kuwait because of the high pressure of anti-war groups, the economic recession, or severe consequences of a military confrontation in the Persian Gulf. The coalition would take none of the these options when it would like to give more time for the economic sanctions to work effectively.

Iraq has a variety of choices before January 15, 1991 , which ranges from unconditional withdrawal from the occupied Kuwait, to launching an offensive against the U.S.-led Allied forces or Israel. These can be summarized in four options: (1) unconditional withdrawal from Kuwait (withdrawal); (2) negotiations, which would lead to some type of conditional withdrawal (negotiations); (3) military offensives (offensives); (4) using nonconventional weapons (nonconventional). Taking the first option would leave the Iraqi military power untouched. However, it would be a loss of face scenario for Mr. Hussein. The second option would ultimately lead to a conditional withdrawal, where Iraq could use withdrawal as a bargaining chip in negotiations. The option of military offensives includes attacks against the Allied forces in Saudi Arabia, Israel, or both, and could be taken initially, or as a response to the offensive option of the U.S.-led Allied forces. The last option could be used as a last straw in

fulfilling Mr. Hussein's promises that Iraq would use anything in its arsenal if attacked, including chemical, biological, or even nuclear weapons. The first option of unconditional withdrawal from Kuwait represents different meanings when taken in different circumstances. It is a voluntary retreat if taken by January 15, while a surrender if taken after a military defeat. One strategy for Saddam Hussein is to do nothing by January 15, 1991, which means making no partial or total withdrawal, no promise to do so, nor any hints of doing so in the near future. By taking this strategy, Iraq would benefit most if Mr. Bush were to offer a deal at the last minute, or at least postpone the attack. However, the highest risk is if the deadline was real. Each of the two decision makers in the conflict accompanied by a list of the options that it controls is written in the left hand column of Table 2.

TABLE 2.
DECISION MAKERS, OPTIONS AND FEASIBLE OUTCOMES IN THE PERSIAN GULF CONFLICT BEFORE THE AIR WAR

U.S.	
Air Strike	0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
Ground War	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1
Negotiations	0 0 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Iraq	
Withdrawal	0 0 0 0 1 0 0 0 0 0 0 1 1 1 1 0 0 0 0 1 1 1 1 1
Negotiations	0 0 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Offensives	0 0 1 1 0 0 1 0 0 1 1 0 0 1 1 0 0 1 1 0 0 1 1 1
Nonconventional	0 1 0 1 0 0 0 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1
Outcome Numbers	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22

Outcomes and Preferences

After identifying the decision makers and their options, the set of outcomes, representing the possible scenarios in the conflict, can be defined by the feasible combinations of the decision makers' options. Some of the outcomes are removed from the analysis because of the low possibilities of taking place in the real situation. For example, the Allied forces would not prefer to negotiate simultaneously with Iraq for a conditional withdrawal while carrying on an air strike or a full scale ground war.

TABLE 3.
OUTCOME GROUPS IN THE PERSIAN GULF CONFLICT

Outcomes	Scenarios	Comments
0	Both the Allies and Iraq do nothing.	The status quo by January 15,1991 and the most preferred outcome by Iraq.
4, 11, 19	Iraq withdraws from Kuwait unconditionally, while the Allies do nothing, launch air strikes, or take both air strikes and a ground war, respectively.	Most preferred outcomes by the U.S.-led Allies.
7, 8, 9, 10	The Allies launch air strikes and Iraq responds with various options, except withdrawal from Kuwait.	Outcomes of military confrontation.
15,16,17,18	The Allies launch both air and ground wars.Iraq responds with various options, except withdrawal from Kuwait.	Outcomes of military confrontation.
12,13,14	The Allies launch air strikes, Iraq responds with various options, and withdrawal is the final result.	Iraq is militarily defeated and surrenders.
20,21,22	The Allies launch both air and ground wars.Iraq responds with various options, and withdrawal is the final result.	Iraq is militarily defeated and surrenders.
5,6	Both sides negotiate for a compromise.	This results in cooperative outcomes which are less referred by the U.S.
1,2,3	U.S. does nothing, while Iraq takes various aggressive actions.	The least preferred outcomes by the U.S.-led Allied forces.

Similarly, Iraq would not be able to withdraw from Kuwait unconditionally while using it as a bargaining chip in negotiations. However, it is possible for Iraq to withdraw from Kuwait after aggressive actions have been taken. Another group of outcomes removed from the model involves a cooperative strategy of

negotiations, which requires that both sides take the strategy simultaneously. Therefore, outcomes involving only one side in the negotiations are all removed from the model. After eliminating the infeasible outcomes, the remaining 23 feasible outcomes are as shown in Table 2. Each outcome is represented by a column of 1's and 0's, where a 1 means that the corresponding option is taken by the decision maker, while a 0 indicates it is rejected. Each outcome is referred to by a number for convenience. Table 3 gives the classifications of the outcomes according to the scenarios represented by the outcomes.

A preference vector (PV) is developed for each decision maker to reflect its interests and goals in the conflict, by ranking all of the feasible outcomes from the most preferred on the left to the least on the right. For the Allies, for example, the primary objective is to get Saddam Hussein out of Kuwait, with or without taking military action. The least preferred outcomes for the coalition are those where the Iraqi withdrawal is linked to an Israeli-Palestinian deal and the Iraqi military machine is left untouched. Accordingly, the group of outcomes from 4 to 22, where the Iraqi troops withdraw from Kuwait, is arranged on the left in the PV for the Allies, denoted by V_A at the top of Table 4. The other three $PV's$ required in the hypergame study are also presented in Table 4, where the subscript A refers to the American-led Allies, while I means Iraq. Returning to the preferences of the Allies, the set of outcomes from 15 to 3, where the Iraqi troops do not withdraw from Kuwait, is on the right in V_A . Given the Iraqi withdrawal from Kuwait, the coalition favors less military action. The most preferred outcome for the U.S. is outcome 4, as well as outcomes 11 and 19, where Iraq totally withdraws, whereas the least preferred scenarios are outcomes 2, 0, 1 and 3, where the U.S. does nothing and Iraq takes various options, except withdrawal. The cooperative outcomes 5 and 6, where both sides negotiate a deal for a conditional withdrawal, are not highly preferred by the Allied forces.

Mr. Hussein is most interested in keeping his troops in Kuwait with as little opposition as possible. Therefore, the favorite outcomes for Iraq are those where the U.S. does nothing and Iraq stays in its "19th province". Next, Iraq likes to negotiate a deal for a conditional withdrawal. Consequently, outcome 0 is the most preferred scenario, followed by outcomes 5 and 6 in the PV for Iraq, denoted by V_I in Table 4. Following this, the group of outcomes from 9 to 3 is more preferred than those from 22 to 4. If military confrontation is involved, Iraq prefers fighting over being expelled from Kuwait. Once military

confrontation breaks out, any means is justified in a "holy war".

In addition to the true PV's, V_A and V_I, which reflect the actual preferences of the decision makers, there are two perceived PV's shown in Table 4, V_{AI} and V_{IA} . The perceived PV's depict how each decision maker is interpreted by its counterpart. V_{AI} is the PV perceived for the Allies (A) by Iraq (I), while V_{IA} is the one perceived for Iraq by the coalition. According to the misperceptions discussed in Section 2.2, the Allies are determined to strongly uphold the UN deadline. However, this determination is suspected by Iraq. Therefore, the perceived PV for the Allies by Iraq, V_{AI}, is different from V_A. Because there are no misperceptions on the Allied side, the perceived PV for Iraq by the Allies, V_{IA}, is identical to the true PV for Iraq, V_I.

TABLE 4.
PREFERENCE VECTORS (PV's) BEFORE THE AIR WAR

1.The Preference Vector for the U.S.-Led Allied Forces (V_A)																								
U.S.																								
Air Strike	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	
Ground War	0	0	1	0	1	0	1	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	
Negotiations	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	
Iraq																								
Withdrawal	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Negotiations	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	
Offensives	0	0	0	1	1	0	0	1	1	0	1	0	1	0	1	0	1	0	1	1	0	0	1	
Nonconventional	0	0	0	0	0	1	1	1	1	0	0	1	1	0	0	1	1	0	0	0	0	1	1	
Outcome Numbers	4	11	19	13	21	12	20	14	22	15	17	16	18	7	9	8	10	5	6	2	0	1	3	

2. The Preference Vector for Iraq (V_I)																								
U.S.																								
Air Strike	0	0	0	1	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	1	1	0	
Ground War	0	0	0	0	0	0	0	1	1	1	1	0	0	0	1	1	1	0	0	0	1	0	0	
Negotiations	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Iraq																								
Withdrawal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	
Negotiations	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Offensives	0	0	1	1	0	0	1	1	0	1	0	1	0	1	1	0	1	1	0	1	0	0	0	
Nonconventional	0	0	0	0	0	1	1	1	1	0	0	0	1	1	1	1	0	1	1	0	0	0	0	
Outcome Numbers	0	5	6	9	7	8	10	18	16	17	15	2	1	3	22	20	21	14	12	13	19	11	4	

3. The Preference Vector for the Allies Perceived by Iraq (V_{AI})																								
U.S.																								
Air Strike	0	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	0	0	0	0	
Ground War	0	0	0	1	1	0	0	1	1	0	0	1	0	1	0	1	0	1	0	0	0	0	0	
Negotiations	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	
Iraq																								
Withdrawal	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Negotiations	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	
Offensives	0	0	1	0	1	0	1	0	1	0	1	0	0	1	1	0	0	1	1	0	1	0	1	
Nonconventional	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	1	1	1	1	0	0	1	1	
Outcome Numbers	4	11	13	19	21	12	14	20	22	5	6	15	7	17	9	16	8	18	10	0	2	1	3	

4. The Preference Vector for Iraq Perceived by the Allies ($V_{IA} = V_I$)																								
U.S.																								
Air Strike	0	0	0	1	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	1	1	0	
Ground War	0	0	0	0	0	0	0	1	1	1	1	0	0	0	1	1	1	0	0	0	1	0	0	
Negotiations	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Iraq																								
Withdrawal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	
Negotiations	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Offensives	0	0	1	1	0	0	1	1	0	1	0	1	0	1	1	0	1	1	0	1	0	0	0	
Nonconventional	0	0	0	0	0	1	1	1	1	0	0	0	1	1	1	1	0	1	1	0	0	0	0	
Outcome Numbers	0	5	6	9	7	8	10	18	16	17	15	2	1	3	22	20	21	14	12	13	19	11	4	

Hypergame Model

A 1st-level hypergame model, H^1, is constructed to describe the situation that existed by January 15, 1991, where the coalition is determined to enforce the UN deadline, and Iraq doubts the strength of the Allies' commitment. In the Iraqi view, the coalition prefers Iraqi withdrawal from Kuwait. If it does not, however, the coalition would like to give more time for the economic sanctions to work effectively, or a cease-fire would be reached soon after the military confrontations break out because of the high casualties and pressure of anti-war groups located both domestically and abroad. This interpretation is based on the Iraqi leaders' confidence in the Iraqi military power and the ground war experiences obtained from their eight year war with Iran. Mr. Hussein believes that a prolonged ground war would result in high American casualties and this would cause American domestic support to quickly vanish. Therefore, both sides

correctly perceive the options and strategies available to each decision maker, but the Iraqis misunderstand the Americans' true preferences. In the overall 1st-level hypergame, H^1, the Americans and Iraqis are playing separate games, denoted as G_A and G_I, respectively. Hence,

$$H^1 = \{G_A, G_I\} = \left\{ \begin{bmatrix} V_A \\ V_{IA} \end{bmatrix} \begin{bmatrix} V_{AI} \\ V_I \end{bmatrix} \right\}.$$

The Allied game, G_A, is composed of V_A and V_{IA}, while the Iraqi game, G_I, consists of V_{AI} and V_I. Because of the misperceptions, $V_{IA} = V_I$, but $V_{AI} \neq V_A$, as shown in Table 4. Consequently, $G_A \neq G_I$.

3.2. Hypergame Stability Analysis

In performing the hypergame stability analysis, a two-step procedure is followed. First, the individual games, G_A and G_I, are analyzed separately in Table 5 using the solution concept of Fraser and Hipel (1979, 1984). The resolutions to the conflict are predicted from the individual viewpoints of each side. In the second step, those individual solutions are combined to from the overall hypergame resolutions to the conflict, shown in Tables 6-8. The final resolutions of the conflict are determined by both decision makers' strategy selections.

Stability Analysis of G_A for the Allied Forces

The stability analysis of G_A for the Allies is given at the top in Table 5. Note that there is a column of outcomes written below some of the outcomes in V_A and V_{IA} to indicate that the corresponding decision maker is able to improve its position leftward in its PV from a given outcome. The three types of improvements explained below are called unilateral improvements (UI's), cooperative improvements (CI's), and noncooperative improvements (NCI's).

In a UI, a specified decision maker unilaterally changes his selection of options to bring about a more preferred outcome given that the option choices or strategy selection of the opponent remain the same. For instance, as shown in the PV labeled V_A in Table 4, the Allies can move from outcome 2, where the Allies do nothing while Iraq takes military offensives, to outcomes 9 or 17, by changing its strategy unilaterally to taking an air strike, or air strike plus a ground war, respectively. Because both outcomes 9 and 17 are preferred by the Allies to outcome 2, they are the Allied UI's from outcome 2, and written in a

TABLE 5.
HYPERGAME STABILITY ANALYSIS BEFORE THE AIR WAR

Stability Analysis of G_A for the U.S.-Led Allied Forces

	x	x	x	x	x	x	x	x	x	x	x	x	x	E	x	x	x	x	x	x	x	x	x	x	**Allied Equilibrium**
U.S.	r	s	s	r	s	r	s	r	s	r	r	r	r	r	u	u	u	u	u	u	u	u	u	u	Individual
V_A	4	11	19	13	21	12	20	14	22	15	17	16	18		7	9	8	10	5	6	2	0	1	3	Stability
		4	4		13		12		14						15	17	16	18	15	17	17	15	16	18	
			11																7	9	9	7	8	10	*UI*'s, *CI*'s or
																					5		5	5	*NCI*'s
																					6		6	6	
Iraq	r	s	s	r	s	s	s	r	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	Individual
V_{IA}	0	5	6	9	7	8	10	18	16	17	15	2	1	3	22	20	21	14	12	13	19	11	4		Stability
		0	0		9	9	9		18	18	18	0	0	0	18	18	18	9	9	9	18	9	0		
			5			7	7			16	16	5	5	5	16	16	16	7	7	7	16	7	2		
							8				17	6	6	6	17	17	17	8	8	8	17	8	1		*UI*'s, *CI*'s or
													2	2	15	15	15	10	10	10	15	10	3		*NCI*'s
														1		22	22		14	14	22	14			
																	20			12	20	12			
																				21	13				

Stability Analysis of G_I for Iraq

U.S.	r	s	r	s	s	r	r	s	s	r	r	s	s	s	s	s	s	s	u	u	u	u	u	u	Individual
V_{AI}	4	11	13	19	21	12	14	20	22	5	6	15	7	17	9	16	8	18	10	0	2	1	3		Stability
		4		4	13			12	14			5	5	5	5	5	5	5	5	15	5	5	5		
				11								6	6	6	6	6	6	6	6	7	6	6	6		*UI*'s, *CI*'s or
													15		17		16		18		17	16	18		*NCI*'s
																					9	8	10		
																									Iraq's Equilibrium
	x	E	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Iraq	r	s	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u		Individual Stability
V_I	0	5	6	9	7	8	10	18	16	17	15	2	1	3	22	20	21	14	12	13	19	11	4		
		0	0	5	5	5	5	5	5	5	5	0	0	0	18	18	18	9	9	9	18	9	0		
			5	6	6	6	6	6	6	6	6	5	5	5	16	16	16	7	7	7	16	7	2		
					9	9	9		18	18	18	6	6	6	17	17	17	8	8	8	17	8	1		*UI*'s, *CI*'s or
						7	7			16	16		2	2	15	15	15	10	10	10	15	10	3		*NCI*'s
							8				17			1		22	22		14	14	22	14			
																	20			12	20	12			
																				21	13				

column below the outcome in V_A within the game G_A in Table 5. Outcome 17 is listed above outcome 9 since it is more preferred by the Allies.

The only cooperative option in the hypergame for the air war is the one called negotiations in Table 2 or 4. To form a *CI*, both decision makers must simultaneously select their option of negotiations, and perhaps also make other option selection changes, in order to jointly or cooperatively move to a cooperative outcome which is more preferred by both decision makers (Hipel and Fraser, 1991). As shown in Table 2, the only cooperative outcomes in the game are outcomes 5 and 6 where both sides are negotiating. In V_A in Table 4, the Allies can improve its position from outcome 2, 0, 1, or 3, to outcome 5 or 6 through negotiations with Iraq. By examining V_{IA} , on the other hand, Iraq is only benefited from the cooperation when it moves from outcome 2, 1, or 3, to 5 or 6, but not from outcome 0, which is more preferred by Iraq to outcomes 5 and 6. Consequently, both decision makers have *CI*'s from outcomes 2, 1, and 3, but not from outcome 0. *CI*'s are written in bold in the same column as the *UI*'s in Table 5. Hence, notice that 5 and 6 are listed in bold under outcome 2 in V_A within the game G_A in Table 5. Likewise, these same two *CI*'s are written under outcome 2 in V_{IA}.

For a *NCI*, a decision maker changes its noncooperative and/or cooperative options to move from a cooperative outcome to a more preferred outcome unilaterally. In doing so, the decision maker drops its cooperative option, and the same thing happens to the other cooperating decision maker. Note that it is necessary for both sides to take their cooperative option simultaneously when they accept cooperation, but either side on its own can reject cooperation by dropping its cooperative option unilaterally.

Consider the *NCI* for Iraq from cooperative outcome 5 to noncooperative outcome 0 in V_{IA} in Table 5. At outcome 5, Iraq can quit the negotiations and bring the conflict situation back to outcome 0, which is the most preferred outcome for it. Consequently, this *NCI*, outcome 0, is written below outcome 5 in bold italic in V_{IA} . As shown in Table 5, the Allies have two *NCI*'s from outcomes 5 and 6.

An outcome may have one of the three types of stability: rational (r), sequentially sanctioned (s) and unstable (u). An outcome is rational for a decision maker when it has no *UI*, *CI*, or *NCI*. For example, outcomes 4, 13 and 12 are rational for the Allies, while outcomes 0, 9 and 18 are rational for Iraq.

An outcome is sequentially sanctioned for a decision maker if, after it invokes

an improvement, its counterpart can make a sequential improvement and bring about a less preferred outcome to the original one for the decision maker, and this can be done for all *UI*'s, *CI*'s, and/or *NCI*'s. An example of s is given for outcome 22 in V_A, where the Allies have a *UI* to outcome 14. However, the *UI* is sanctioned by a sequential improvement of Iraq from outcome 14 to outcome 9, which is less preferred by the Allies to the original outcome 22. Therefore, outcome 22 becomes sequentially sanctioned for the coalition and is marked as s. An outcome is unstable for a decision maker if there is at least one unsanctioned *UI, CI*, or *NCI* from the given outcome. Accordingly, all the outcomes in V_A and V_{IA} are marked as r, s or u.

An outcome is a perceived equilibrium, denoted by writing an E above it, if it is stable for both decision makers according to the individual stability. Otherwise, it is not an equilibrium and is marked by a x. There is only one equilibrium in G_A: noncooperative outcome 18, which the Allies envision coming about in G_A.

TABLE 6.
DYNAMIC PROCESS FROM THE STATUS QUO

Outcomes	Changes in U.S. Strategy	Changes in Iraqi Strategy	Comments
0	Do nothing	Do nothing	The status quo by January 15.
7	Air strike	Do nothing	The first couple of days of the war.
9	Air strike	Military offensives	The situation before the ground war when Iraq launched Scud missiles at both the Allies and Israel and it sent small ground forces against the Allies.
17	Air strike and ground war	Military offensives	A ground war is launched when the Iraqi troops remain in Kuwait.
18*	Air strike and ground war	Military offensives and non-conventional weapon	Non-conventional weapons are used by Iraq when the war goes badly in Kuwait.

NOTE:

1) The underlined strategies are the moves and countermoves made by each decision maker sequentially.
2) Outcome 18 is the final equilibrium in the dynamic process

The equilibrium 18 represents a situation where the U.S. launches both an air campaign and a ground war, while Iraq responds with military offensives, including sending Scud missiles to attack the Allied forces and Israel, ground battles, as well as the use of non-conventional weapons. The dynamic process, that leads the conflict from outcome 0, the status quo by January 15, 1991, to equilibrium 18, is shown in Table 6. The process does not bring about a scenario where Iraq would be forced out of Kuwait, which is represented by outcome 22, because outcome 22 is less preferred by Iraq than outcome 18. In a real world conflict, however, a decision maker could be forced to take some strategies reluctantly, even though it is less preferred than the one it starts with, and this is what happened in the real course of the conflict.

Stability Analysis of G_I for Iraq

The stability of the outcomes in V_{AI} and V_I in G_I for Iraq are shown at the bottom of Table 5. The equilibrium perceived by Iraq is the cooperative outcome 5. Therefore, Iraq is taking the strategy of negotiations with the Allies. But, the realization of equilibrium 5 depends also on the Allied strategy selection, which is determined in G_A. The equilibrium perceived by Iraq is presented in Table 7.

TABLE 7.
EQUILIBRIUM PERCEIVED BY IRAQ

	The Allied Strategy	The Iraqi Strategy
5	Negotiations	Negotiations

TABLE 8.
THE HYPERGAME EQUILIBRIUM

	The U.S.-Led Allied Forces	Iraq
Individual Equilibria	18	5
Strategy selected by the decision makers	Air strikes and a ground war	Negotiations
Overall Equilibrium	15	

Overall Stability Analysis of H^1

Even though a decision maker may make mistakes in its perception, the final resolutions to a conflict are determined by decisions made by both sides. From the knowledge of individual stability analyses, the likely decisions for the two sides by January 15, 1991, are that the U.S.-led Allies will take a strategy of launching air strikes and subsequently a ground war, while Iraq wants to negotiate for a deal, which was exactly what happened on January 15. Given the equilibria perceived by the decision makers, the crisis would eventually evolve to an intensive military confrontation, where the U.S.-led Allied forces would launch air strikes and a full scale ground war, while Iraq, after seeing its misperceptions, would respond with military offensives, even the use of nonconventional weapons. Consequently, the eventual overall result is outcome 15 followed by 18. Once the war breaks out, the American willingness is no longer questionable, miscalculations become irreversible regrets, and the war goes on according to the course shown in Table 6.

4. Hypergame Analysis Before the Ground War

4.1. The Hypergame Structure

By February 23, the beginning of ground war, Mr. Hussein was deceived by the Allied strategy and believed mistakenly that the main invasion would come from the front-line along the Saudi-Kuwaiti border and from the sea. Consequently, Mr. Hussein concentrated his 535,000 troops in these areas as well as along the Iraqi-Kuwaiti border. While waiting for a prolonged and bloody ground war, Saddam Hussein hoped to negotiate a deal for his withdrawal from Kuwait. Because of these miscalculations, President Hussein did not act quickly enough to take advantage of the Soviet peace effort that was attempted just before the ground war, and lost the last chance to withdraw from Kuwait. Meanwhile, the Allies were ready to strike the last blow at the Iraqi troops stationed in Kuwait. The Allies successfully deceived Iraq by taking a secret option of attacking along the western flank, as well as at the front-line. Iraq was fooled into believing that a seaborne invasion would take place when a ground war started. The option was actually not in the Allied menu. Table 9 lists the actual options available to each side as well as the Allied options that are perceived by Iraq.

TABLE 9.
PERCEPTIONS AND MISPERCEPTIONS BEFORE THE GROUND WAR

The Allied Perceptions		The Iraqi Misperceptions	
The True Allied Options	The Iraqi Options Pereceived by the Allies	The Allied Options Peceived by Iraq	The Iraqi Options
1.Attack at front-line	1.Defend front-line	1.Attack at front-line	1.Defend front-line
[2] Attack along the western flank	2.Defend along coast	②Seaborne invasion	2.Defend along coast
·	3. Negotiations	③ Negotiations	3. Negotiations

[2] The secret Allied option which is unknown to Iraq.

② The imagined option for the Allies perceived by Iraq, which is not in the Allied menu.

③ The imagined option for the Allies perceived by Iraq, which is not in the Allied menu.

TABLE 10.
DECISION MAKERS, OPTIONS AND FEASIBLE OUTCOMES BY FEBRUARY 23, 1991

1. As Interpreted by Iraq														
U.S.	1. Attack front-line	1	0	1	1	0	1	1	0	1	0	0	0	0
	②Seaborne invasion	0	1	1	0	1	1	0	1	1	0	0	0	0
	③Negotiations	0	0	0	0	0	0	0	0	0	1	1	1	1
Iraq	1. Defend front-line	1	1	1	0	0	0	1	1	1	0	1	0	1
	2. Defend coast	0	0	0	1	1	1	1	1	1	0	0	1	1
	3. Negotiations	0	0	0	0	0	0	0	0	0	1	1	1	1
Outcome Numbers		9	10	11	17	18	19	25	26	27	36	44	52	60
2. As Interpreted by the Allies														
U.S.	1. Attack front-line	1	1	1	0	0	0	1	1	1				
	[2] Attack west flank	0	0	0	1	1	1	1	1	1				
Iraq	1. Defend front-line	1	0	1	1	0	1	1	0	1				
	2. Defend coast	0	1	1	0	1	1	0	1	1				
	3. Bargaining	0	0	0	0	0	0	0	0	0				
Outcome Numbers		5	9	13	6	10	14	7	11	15				

Due to the misperceptions summarized in Table 9, the options, strategies, outcomes, and PV's are all different in the hypergames played by Iraq and the coalition. The decision makers, their options and feasible outcomes interpreted

by each side are given in Table 10, with the Iraqi misperceptions on the top and the Allied perceptions at the bottom.

A second level hypergame, H^2, is used to reflect the situation where Iraq plays its game, G_I, while the U.S.-led Allied forces foresee the Iraqi mistakes. Consequently, the Allied game consists of two parts: its own game and the Iraqi game perceived by the Allies. The 2nd-level hypergame, H^2, is given as:

$$H^2 = \{H_A^1, G_I\},$$

where $G_I = \{V_{AI}, V_I\}$,

$$H_A^1 = \{V_A, G_{IA}\} = \{V_A, V_{IA}, V_{AIA}\}.$$

G_I is the game played by Iraq, while H_A^1 is the 1st-level hypergame played by the U.S.-led Allied forces. G_I consists of two PV's: V_I , the true Iraqi PV, and V_{AI}, the PV for Allies perceived by Iraq. H_A^1 consists of three PV's: V_A, the true PV for the Allies, and two perceived PV's, V_{IA} and V_{AIA}, which form Iraq's game. Because the Allies correctly perceive the miscalculations of Iraq, $V_{IA} = V_I$ and $V_{AIA} = V_{AI}$, where V_{AIA} means the Allied understanding of Iraq's perceptions of the Allies. The game structure is depicted in Figure 1 , where two separate branches are shown for the individual game structures, G_I is a zero-level hypergame, H_A^1 is a 1st-level hypergame, while the integration of the individual games is at the 2nd-level. For detailed definitions of any kind of hypergame structure, the reader can refer to the research of Wang et al. (1988a).

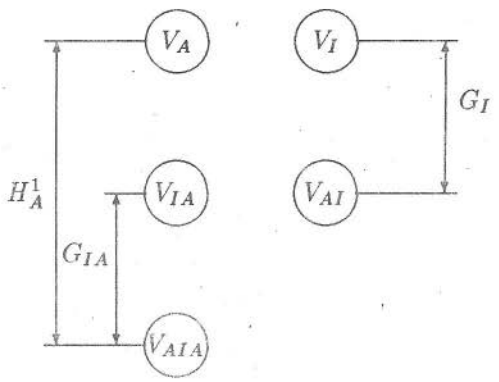

Fig. 1. The 2nd-level Hypergame Structure of the Persian Gulf Crisis before the Ground War.

4.2. The Game G_I Played by Iraq

Based on the Iraqi misperceptions, there are three options perceived for each decision maker and 13 feasible outcomes in G_I, which are given in Table 10. Table 11 shows the stability analysis of G_I. Saddam Hussein perceives two groups of equilibria: cooperative equilibria 36, 44 and 52, and a noncooperative equilibrium 25. In the cooperative equilibria, Iraq expects to negotiate a conditional withdrawal, while in equilibrium 25, it would defend the front-line along the Saudi-Kuwaiti border and the Kuwaiti coast, while waiting for the main Allied attack to take place along the front line.

TABLE 11.
THE INDIVIDUAL STABILITY ANALYSIS OF G_I FOR IRAQ

U.S.	r	r	s	s	r	u	r	s	s	u	u	u	u	Individual Stability
V_{AI}	10	17	11	19	25	26	36	44	52	60	9	18	27	
			10	18		25		**10**	**17**	**25**	10	17	25	
								11	**19**	**26**	11	19	26	
											36	**36**	**36**	*UP*s, *CP*s or *NCP*s
											44	**44**	**44**	
											52	**52**	**52**	
											60	**60**	**60**	
	x	E	E	E	E	x	x	x	x	x	x	x	x	**Iraq's Equilibria**
Iraq	r	s	s	s	r	r	u	u	u	u	u	u	u	Individual Stability
V_I	60	44	52	36	25	26	17	9	18	11	19	10	17	
		60	60	60			**60**	**60**	**60**	27	27	26	25	
			44	44			**44**	**44**	**44**		11	18	9	*UP*s, *CP*s or *NCP*s
				52			**52**	**52**	**52**					
							36	**36**	**36**					
								25	26					

4.3. The Game H_A^1 Played by the U.S.-Led Allied Forces

The stability analysis of H_A^1 for the coalition is carried out in two steps: first, G_{IA} is analyzed so that the Iraqi equilibria are perceived; then, the stability is calculated for V_A, which provides the basis for the Allied decision. In G_{IA} , the allied option of seaborne invasion is incorrectly imagined by Iraq because the misperception is encouraged by the Allies even though they have no intention of landing troops on the beaches of Kuwait. Because it correctly perceives Iraq's game and its equilibria, the U.S.-led coalition knows that Iraq is defending

at both the front-line and along the coast. In V_A, therefore, only the group of outcomes involving the strategy of defending both places is considered in the stability analysis for V_A (Table 12). Outcome 15 is most preferred by the coalition, and therefore, is the coalition's equilibrium, where the Allies attack on the west flank and the front-line, while the Iraqi troops defend along the front-line and coast.

TABLE 12.
THE INDIVIDUAL STABILITY ANALYSIS IN H_A^1

The group of outcomes analyzed in the Allied game				
U.S.	attack front-line	1	0	1
	attack west flank	0	1	1
Iraq	defend front-line	1	1	1
	defend coast	1	1	1
	bargaining	0	0	0
		13	14	15
The stability analysis of G_{IA} is identical to that given in Table 11.				

4.4. Overall Stability Analysis of H^2

The overall equilibrium to the 2nd-level hypergame, H^2, is given by combining the strategic selections of both decision makers. According to the individual stability analyses, Iraq would defened the front-line along the Saudi-Kuwaiti border and the Kuwaiti coast, while the Allies launch an unexpected attack on the west flank and the front-line. That forms outcome 15, which is exactly what happened in the conflict. The secret option of attacking along the western flank was certainly a strategic surprise to Iraq. By the time Iraq became aware of the covert option available to the U.S.-led Allied forces, it was too late for Saddam Hussein to do anything to redeem his strategic miscalculation.

5. Conclusions

In this paper, the Persian Gulf war is modelled as hypergames with respect to the conflicts existing just before the air and ground wars when misperceptions seriously affected the decisions made by the decision makers. The conflict is modelled as a 1st-level hypergame prior to the beginning of the air campaign, when Iraq had misinterpretations about the coalitions' preferences, which in turn led to the Iraqi miscalculations about the possible consequences of the

confrontation. By Feb. 23, the beginning of ground war, Iraq was deceived by the strategic surprise of the secret outflanking option available to the Allied forces. A 2nd-level hypergame is used to reflect the situation, where the U.S.-led coalition was aware of the Iraqi strategic mistakes.

By using hypergame analysis, the conflict resolutions to the war are predicted given the decision maker's perceptions and misperceptions. At the first point in time, January 15, the predicted resolution is outcome 15 which immediately leads to outcome 18, where the U.S.-led forces launch both air strikes and a ground war against the Iraqi troops in occupied Kuwait, while Iraq responds with non-conventional weapons (Table 6). In fact, not a single chemical weapon was ever fired, even though U.S. Marines did find stocks of poison-gas shells in front-line positions. Various speculations are suggested after the war to conjecture the reasons why Saddam Hussein failed to fulfill his threat. It might be that the Iraqi artillery, the main delivery system for chemical shells, was too badly damaged in air raids to launch a concerted attack; or the chemicals themselves were no longer potent after being stored for months at the front; or the Allied forces broke through the Iraqi defenses so quickly, and were moving so fast that surviving artillery units, lacking airborne spotters, could not locate their opponents. It is also possible that fear of being held personally responsible for the use of chemical weapons had deterred Iraqi commanders, including President Hussein, from issuing the order. The communications between Baghdad and the field were so disrupted that it might have been impossible for Saddam to transmit the order in any case. Finally, the weather had turned rainy and windy, a less than ideal environment for using gas or nerve agents, and the wind was blowing from the South, which could have carried any chemicals in the air right back into Iraqi faces (Church, 1991b). Nevertheless, the hypergame analysis highlights the dynamic process on how the conflict progressed from the status quo of January 15 to the end of the war, when Iraq was defeated.

In the 2nd-level hypergame for February 23, misperception occurred not only in the preferences, but also in the outcomes perceived by Iraq because of the strategic surprise. Perceiving the mistakes of Iraq, the U.S.-led Allied forces attacked along the western flank and also the front-line, while Iraq defended at the front-line and the coast, which is exactly what happened historically.

As demonstrated by the Persian Gulf war, the hypergame analysis methodology can be used successfully for modelling and analyzing conflicts with misperceptions. An actual dispute can be modelled realistically by allowing each

decision maker to interpret the game from his own viewpoint, even though the decision maker may have a false understanding of reality. Moreover, due to the flexible hypergame structure, a hypergame can be constructed at various levels according to the complexity of a situation. Besides accurately predicting the possible resolutions to a conflict, hypergame analysis provides a better understanding of the role of misperception and how a conflict develops from its status quo to one of its resolutions. Finally, the first hypergame application of Section 3 was carried out before the air war and correctly predicted what eventually took place. This case study demonstrates that hypergame analysis can be used in real time for studying current disputes.

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