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Explaining Limited Conflicts

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This report uses a generic two-stage escalation model to ask whether and when limited conflicts can occur. There are two players in the model: Challenger and Defender. Challenger can either initiate a conflict or not. If Challenger initiates, Defender can concede, respond-in-kind, or escalate. If Defender does not concede, Challenger can escalate. The process continues until one side concedes or both escalate.

Limited conflicts do not occur in our model when information is complete or when Defender's threat to respond-in-kind is seen to be completely noncredible. They are also extremely unlikely when Defender is seen strictly to prefer a response-in-kind to immediate capitulation when challenged. Limited conflicts are most probable under a Constrained Limited-Response Equilibrium (CLRE). Constrained Limited-Response Equilibria only occur when there is uncertainty about Defender's willingness to respond-in-kind to an initiation. The conditions associated with the existence of a CLRE and the other equilibria of the model are illustrated, both graphically and via a numerical example. Typically, under a CLRE, Challenger initiates and Defender concedes. From time to time, however, Challenger misjudges Defender's intentions and is surprised by a limited response. At this point, Defender chooses not to escalate the conflict because it concludes that Defender will counter-escalate and an all-out conflict will occur. Real-life examples of this process include the Gulf War, the Cuban Missile Crisis, the Fashoda Crisis of 1898, and the Korean crisis of 1950.

Keywords limited conflict, escalation, deterrence.

The question of whether escalation can be controlled, whether conflicts can be limited, is not new. Freedman (1989), for instance, traces the now voluminous literature on limited war to the interwar period and the work of Lidell Hart.[1] Gacek (1994) points to the early conceptual contributions of Jacob Viner, Paul Nitze, and George Kennan. Nonetheless, contemporary thinking about limiting conflict is largely a product of the nuclear age and the dissatisfaction of theorists like Brodie (1954), Kissinger (1957), Kaufmann (1956), and Osgood (1957) with the Eisenhower administration's "New Look" policy. Given the entirely reasonable fear of a superpower war during the 1950s and 1960s and the immense risks associated with

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[1] See also Freedman (1987).

nuclear weapons, strategic thinkers were motivated to speculate about the conditions under which a crisis could be managed, a limited military engagement contained, and an all-out conflict avoided.

Some simply prejudged the question. For example, spiral theorists (Jervis, 1976) and proponents of existential deterrence (Bundy, 1983) take the escalation of conflict as axiomatic. In their view, escalation is a semi-autonomous, semi-automatic process operating largely outside human control. Accordingly, restraint in war, however desirable, is unlikely; substrategic conflicts tend to spiral inexorably out of control and culminate in unlimited, no-holds-barred, confrontations. Formal models that reflect this view of escalation describe "what people would do if they did not stop to think" (Richardson, 1960: 12).

Other analysts, however, started from the premise that escalation is *potentially* controllable. Daring to "think the unthinkable" (Kahn, 1962), some classical (or rational) deterrence theorists saw escalation as a complex strategic problem "involving not only assessment of the immediate advantage to one's own side, but also [the] difficult and often painfully uncertain calculation of the possibilities for counter-escalation by the enemy" (Smoke, 1977: 4).

Thomas Schelling's (1960, 1966) explorations of the strategic foundations of the escalation process were seminal. Conceptualizing escalation as the deliberate violation of a saliency, Schelling and other manipulative bargaining theorists (Young, 1968) devised provocative mechanisms for exploiting intrawar negotiations. An elaborate description of this process, put forward by Herman Kahn (1965: 39), included an *escalation ladder* with 44 distinct rungs, rising from ostensible crisis to "central war."

Underlying the analyses of escalation theorists like Schelling and Kahn was the assumption that all-out war would be disastrous for all involved. Only this assumption, apparently so reasonable that it was usually left unstated, can account for the ubiquity of the game of "Chicken" in the early literature of both deterrence and escalation. In this simple game, war or conflict is a mutually worst outcome and, hence, always "irrational." Later, more elaborate game-theoretic models developed by Powell (1987), Nalebuff (1986), and others made precisely the same assumption.

The assumption, however, is clearly problematic. If war is presumed to be irrational, it follows that the threat to initiate war is also irrational and, therefore, lacking in credibility. Some theorists recognized the inconsistency but were unconcerned. Nimbly juggling what Trachtenberg (1991: 4) characterizes as two "fundamentally inconsistent" ideas, they took the irrationality of war as a given but nonetheless attempted to divine how the threat of war could be used to political advantage. Schelling's (1966) notorious suggestion that, during a crisis, rational statesmen feign irrationality in order to gain a strategic advantage is a reflection of this inconsistency, as is Brodie's (1959: 293) comment that "for the sake of deterrence before hostilities, the enemy must expect us to be vindictive and irrational if he attacks us."[2]

Not all theorists, however, were comfortable with the contradiction. Instead, some sought to overcome the "paradox of deterrence" by asserting that, although wartime policy makers were rational, they were also not "fully in control of events" (Schelling, 1966: 97). When two states face off during an acute crisis, then, a random incident might set off a series of actions and reactions leading mindlessly and inexorably to a war that no one wants. Thus rational decision makers might—under the right circumstances—be deterred from escalation because of fear of an inadvertent or accidental war rather than by the fear of irrational retaliation.

[2]More recently Krauthammer (2002), expressing the same sentiment, opined that "the iron law of the nuclear age is this: nuclear weapons are instruments of madness; their actual use would be a descent into madness, but the threat to use them is not madness. On the contrary, it is exceedingly logical."

Precisely how things might get out of control, though, was not specified (Maxwell, 1968). Some crisis models supposed the existence of an impersonal force called "Nature" that makes choices without reference to the preferences, or to the interests, of the players. In these models, the players themselves never explicitly decide to precipitate war, but they might take an action that, by forfeiting control, raises the "autonomous risk of war." This was Schelling's (1966: 121) "threat-that-leaves-something-to-chance."

But the view of a crisis as "a competition in risk taking" lacks empirical support. The extremely cautious behavior of Soviet and United States decisionmakers during the most acute international crises of the Cold War, for example, suggests that the superpowers were not prone to precipitous action that, by rocking the boat a little too far, could start an inevitable slide toward thermonuclear war. In fact, "commitment" and related manipulative bargaining tactics have never been standard tools of crisis management (Young 1968; Snyder & Diesing 1977; Richardson 1994; Huth, 1999; Danilovic, 2002). As Betts (1987: 30) observes, "the view that apparent recklessness and irrevocable commitment are more effective is usually more comfortable to pure strategists than to presidents."

Deterrence, Escalation, and Perfect Deterrence Theory

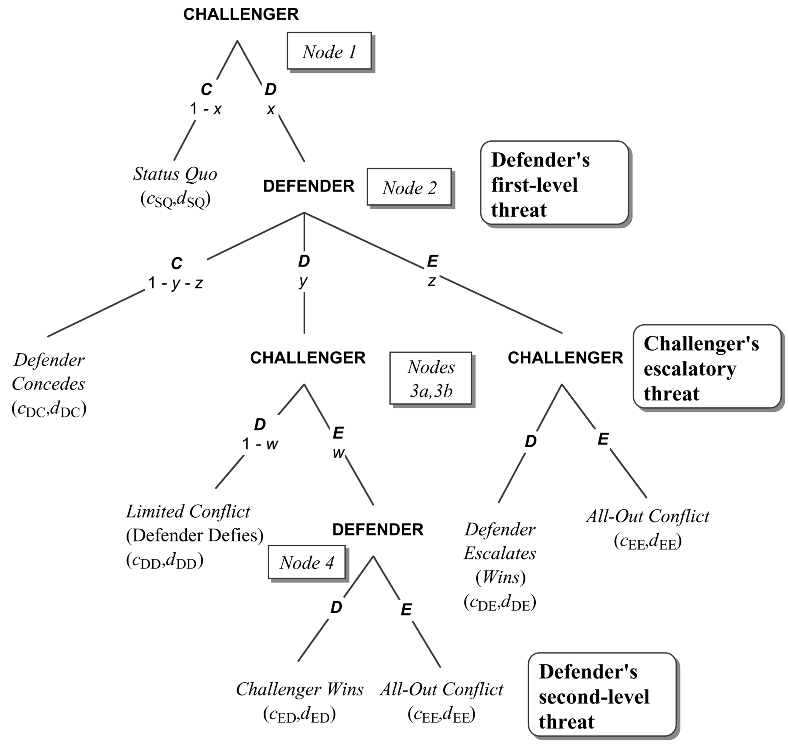
Is there a force that makes conflict escalation inevitable, as some have argued was the case in August and early September of 1914? Or is the Korean War, in which U.S. war aims were apparently scaled back following the unexpected entry of China into the conflict, a more typical and instructive example? In this article we use Perfect Deterrence Theory (Zagare & Kilgour, 2000) to answer these questions about the escalatory process. Our objective is to understand whether a conflict between *rational* actors can be capped and, if so, under what conditions.

Unlike spiral theory, Perfect Deterrence Theory does not take the escalation of conflict as a given. And unlike classical deterrence theory (Zagare, 1996), which begins with the supposition that war or conflict is *necessarily* the worst outcome for both sides, Perfect Deterrence Theory leaves open the possibility that one or both sides prefer(s) war to capitulation.[3] By treating the credibility of end-game threats as an important strategic variable rather than as a constant, Perfect Deterrence Theory is able to ask, without fear of logical contradiction, whether and when a conflict might rationally be capped. Note also that in Perfect Deterrence Theory the principal source of a player's risk is the opponent's threat, not some impersonal force called Nature.

To explore the relationship of credibility, escalation, and limited warfare, we use the Asymmetric Escalation Game shown in Figure 1. This generic model is applicable to any conflict situation in which two decisionmakers have a common understanding of the existence of a saliency (in the sense of Schelling, 1960): a real or psychological barrier constitutes a saliency if (1) both sides have complete and accurate information about whether the barrier has been crossed, and (2) crossing it implies a substantial escalation of the conflict. Although the Asymmetric Escalation Game can represent any asymmetric conflict initiation problem with one saliency, our interest in great power rivalries leads us to interpret it as a model of intense interstate disputes.

The Asymmetric Escalation Game is a non-cooperative game with two players, Challenger and Defender. Challenger makes the first move at node 1, choosing whether to *cooperate* (C) and take no aggressive action, or to *defect* (D) by *demanding* a change of the status quo. If Challenger selects C, the game ends and the *Status Quo* (outcome SQ) is maintained. The payoffs to the players—c for Challenger, d for Defender—at outcome

[3]For a detailed discussion of the differences between classical deterrence theory and Perfect Deterrence Theory, see Zagare (2004).



Key:

Challenger: ***C*** **= Cooperate**
D **= Demand**
E **= Escalate**

Defender: ***C*** **= Concede**
D **= Defy**
E **= Escalate**

x = probability Challenger initiates at node 1
w = probability Challenger escalates at node 3a
y = probability Defender responds-iu-kind at node 2
z = probability Defender escalates at node 2

FIGURE 1 Asymmetric escalation game.

SQ are given by the ordered pair (c_{SQ}, d_{SQ}). [The players' utilities at any outcome K are denoted (c_K, d_K).]

But if Challenger defects and initiates a conflict, Defender is faced with its own choice. Specifically, at node 2 Defender must decide whether to *concede* or *capitulate* (*C*) by meeting Challenger's demand, to *defy* (D) Challenger by resisting (i.e., by responding-in-kind), or to *escalate* (E) by taking some action that violates a saliency. If Defender capitulates, Challenger gains an advantage, the outcome is DC (*Defender Concedes*), and the payoffs to the players are (c_{DC}, d_{DC}).

If, however, Defender chooses either D or E, Challenger faces a second choice at node 3a or 3b: Challenger must decide whether to escalate (E) or to stick with its previous choice of D. Challenger's choice at node 3b ends the game at either outcome DE (where *Defender Escalates/Wins*) or EE (where there is *All-Out Conflict*). *Limited Conflict* (outcome DD) occurs if Challenger decides not to escalate at node 3a. If Challenger escalates at node 3a, Defender is afforded a second opportunity to (counter-) escalate at node 4. In this case, either *Challenger Wins* (outcome ED) if Defender decides not to escalate, or *All-Out Conflict* ensues (outcome EE) if Defender matches Challenger's escalation choice.

It is important to emphasize that the specific sequence of choices in Figure 1 may lead to two distinct forms of sustained conflict: *Limited Conflict* occurs at a lower level (outcome DD) if both players choose (and stick with) D, while *All-Out Conflict* (outcome EE) occurs at a higher level if both players eventually escalate. We know of no other model in which choices resulting in two distinct levels of conflict are represented. It is this feature of the Asymmetric Escalation Game that allows us to explore the conditions under which conflict can be limited.[4]

Assumptions

To model the escalation process, we make several assumptions about the players' preferences over the outcomes of the Asymmetric Escalation Game. First, we assume that Challenger always strictly prefers DC to SQ, that is, it prefers to defect, *provided that Defender does not retaliate*. Without this assumption Challenger has no immediate incentive to upset the status quo.

We also assume that each player prefers to gain the upper hand or, if it comes to it, lose the advantage, at the lowest possible level of overt conflict. Because of this assumption, we focus on players who prefer to win (by out-escalating the opponent) but who are at the same time cognizant of the costs associated with escalation. We believe that limited conflicts that evolve under these extreme conditions are more interesting theoretically than those in which the players are not motivated to escalate. Thus we assume that once conflict has been initiated, Defender prefers to escalate (i.e., prefers DE to DC), *provided Challenger does not respond by also choosing E.* Similarly, we presume that Defender prefers outcome DC to ED, as does Challenger. All retaliatory threats are taken to be *capable* in the sense that a player who initiates conflict ends up worse off if the other player retaliates (Schelling, 1966; Zagare, 1987: ch. 4). This means that both players prefer the *Status Quo* to *Limited Conflict*, and *Limited Conflict* to *All-Out Conflict*. Note that our conclusions about the possibility of limited conflict do not apply when one or more players actually prefers *Limited Conflict* to the *Status Quo*. Limited wars that occur under these conditions are empirically relevant, but they are also easy to explain theoretically (Zagare & Kilgour, 2000).

Although Defender's preference is to escalate unilaterally should Challenger precipitate a crisis, no fixed assumption is made about Defender's preference between capitulating to Challenger's demands (outcome DC) and responding-in-kind (outcome DD). We leave this preference relationship open; some Defenders may prefer to retaliate, but others, lacking a credible low-level option, may prefer to capitulate. (The Eisenhower administration's preference against land wars in Asia is a case in point.)

Similarly, Challenger's and Defender's preferences between capitulating and fighting an all-out war are also left open. Depending on the stakes and the costs of conflict, one or both may sometimes prefer *All-Out Conflict* (EE) to capitulation (either ED or DE), and sometimes the opposite.

Taken together, these postulates establish the following restrictions on the players' utilities:

$$\text{Challenger} : c_{\text{DC}} > c_{\text{SQ}} > c_{\text{ED}} > c_{\text{DD}} > [c_{\text{EE}} \text{ and } c_{\text{DE}}]$$

$$\text{Defender} : d_{\text{SQ}} > d_{\text{DE}} > [d_{\text{DD}} \text{ and } d_{\text{DC}}] > [d_{\text{EE}} \text{ and } d_{\text{ED}}].$$

[4]All conflicts, whether limited or all-out, must end. Normally, termination occurs when one side or the other capitulates. To simplify our model we have not included capitulation choices for either player at either *Limited Conflict* or *All-Out Conflict*. Rather, we assume that the players' utility evaluations take account of the possible ways these two conflict outcomes can play out.

The three preference relationships—one for Challenger and two for Defender—that are enclosed in brackets are not fixed in the Asymmetric Escalation Game model.

These are exactly the preference relationships that we believe are the critical determinants of interstate conflict behavior. They are critical because they underlie the *credibility*, or lack thereof, of each player's retaliatory threat at each level of play. Following Selten (1975), we associate the credibility of a player's threat with the extent to which that player is seen to prefer to execute it. For example, the credibility of Defender's first-level threat is determined by Challenger's perception of Defender's evaluation of outcomes DC and DD. If Challenger believes Defender prefers *Limited Conflict* (DD) to *Defender Concedes* (DC), then Defender's first level threat is credible; otherwise it is incredible. Similarly, Defender's second-level threat is credible if and only if Challenger believes that Defender prefers EE to ED.

The actual (as opposed to perceived) credibilities relevant to the Asymmetric Escalation Game encompass two possibilities for Challenger and four for Defender: Challenger's second-level threat is either credible or non-credible, while Defender's threats can be credible or non-credible at both the first level and the second level. Players with a credible threat are called *Hard* (H); players without a credible threat are called *Soft* (S). Challenger, therefore, may be of two *types*, Hard and Soft, while Defender may be of four, Hard/Hard, Hard/Soft, Soft/Hard, and Soft/Soft. A Soft/Hard Defender, for example, has a credible threat of escalating to the highest level, but not to retaliate at a lower level. Such a Defender may be relying on a "Massive Retaliation" defense posture.

Thus $2 \times 4 = 8$ distinct preference configurations are relevant in the Asymmetric Escalation Game. Of course, players always know their own preferences, i.e., their own types. We next assess the possibility of *Limited Conflict* (outcome DD) when Challenger and Defender both have complete and certain knowledge of each other's type as well.

Escalation Under Complete Information

When preferences are common knowledge, backward induction can be used to determine the subgame perfect equilibria of the Asymmetric Escalation Game. For each of the eight possible combinations of player types (or actual credibilities), there is a unique subgame perfect equilibrium, as can be verified directly by backward induction on the game of Figure 1. It is easy to show that two conditions are sufficient for the stability of the status quo. Under complete information, deterrence works either when Challenger is Soft or when Defender has a credible threat at each level of the game, that is, Defender is of type Hard/Hard (H/H). Conversely, for deterrence to fail, Challenger must be Hard, and Defender's threat must be non-credible at either the first or the second level.

It is significant that, under complete information, the status quo is stable when *neither* player possesses a credible threat at either level. This characteristic of two-level escalation games contrasts sharply with that of one-level deterrence games. The *Status Quo* is not an equilibrium in a one-level game in which each player lacks a credible retaliatory threat (Zagare, 1987; Powell, 1990). Thus, the addition of a second level to a game may enhance the stability of a deterrence relationship. In fact, the stated rationale for "Flexible Response" deployments rests upon this very premise (see Zagare & Kilgour, 1995).

Finally, it can be demonstrated that when the players have certain knowledge of each other's preferences, neither *Limited Conflict*, nor *any* outcome associated with an escalation move by either player, ever occurs at equilibrium. In particular, *Limited Conflict* (DD) is rationally precluded. When the players know each other's preferences, only two sequences of events are possible: either deterrence succeeds and the outcome is the *Status Quo*, or Challenger initiates and Defender capitulates immediately, producing *Defender Concedes*.

This should not be taken to imply that limited conflicts are not possible under complete information. There are many situations to which the fixed preferences assumed in the Asymmetric Escalation Game model may not apply. For instance, if Defender's first-level threat lacks *capability*, a low-level conflict could emerge as a subgame perfect equilibrium.[5] It is not difficult to understand why. Recall that threat capability is defined in terms of each player's preference between an initial standoff outcome (SQ or DD) and the outcome that results if that player initiates and the opponent retaliates, producing the next level of standoff (DD or EE). To say, then, that Defender's first-level threat is not capable is to say that Challenger actually prefers a *Limited Conflict* to the *Status Quo*. (In this case, Defender's threat is not capable because its execution simply does not hurt Challenger.) In one-level games of complete information, a capable retaliatory threat is a necessary condition for stable deterrence (Zagare, 1987). In a two-level game of complete information, the absence of a capable threat is a necessary, though not a sufficient, condition for limited conflict.

The Belgian threat to resist a German invasion in 1914 is an example of a threat that lacked both credibility and capability. It lacked credibility because Germany did not believe that Belgium preferred to resist. It lacked capability because Germany's preference for invasion did not depend on Belgium's intentions—whether or not Belgium planned to resist, Germany preferred to invade (Tuchman, 1962: 40). By contrast, the British threat to defend Belgian neutrality may have been capable, but it was not credible. German Chancellor Theobald von Bethmann Hollweg simply did not think Britain would fight (Massie, 1991). Had it been credible, Germany's actions might have been more circumspect.

A somewhat different configuration of threat characteristics helps shed light on the Seven Weeks' War, the limited conflict between Austria and Prussia in 1866. Prussian Minister-President Otto von Bismarck instigated a conflict with Austria because Austria's first-level threat lacked capability. But a wider war was avoided because the second-level French threat to defend Austria's integrity appears to have been both credible and capable (Smoke, 1977, chapter 5). The nature of the French threat helps explain why Bismarck, contrary to the advice of the Prussian general staff, offered the Austrians generous peace terms after the decisive Prussian victory at Königgrätz (Sadowa).

Escalation and Incomplete Information

The Seven Weeks' War is typical of limited conflicts waged when information about preferences is complete (Huth & Russett, 1988: 38).[6] In this case, one side (Prussia) enjoyed important tactical advantages that transformed an apparently even contest into a rout. In terms of our model, the asymmetric military situation rendered Austria's first-level threat incapable, so Prussia simply could not be deterred from low-level initiation.

The more problematic cases, however, involve tactical and strategic parity. For instance, are limited conflicts possible when two opponents are fully capable of inflicting unacceptable costs on one another at *every* conflict level? Since these are precisely the conditions under which great power disputes are likely to escalate into major wars (Organski & Kugler, 1980), this question is central to understanding limited warfare.

[5]For example, if Challenger's preference order is $c_{DC} > c_{ED} > c_{DD} > c_{SQ} > c_{EE} > c_{DE}$, *Limited Conflict* (outcome DD) is an equilibrium provided Defender's first and second level threats are credible. Other outcomes can be subgame perfect equilibria under other preference assumptions.

[6]Strictly speaking, there was an asymmetry of information in the Seven Weeks' War. The Prussians clearly had private information about the tactical advantages of their breech-loading rifle over Austria's muzzle-loading guns (Blainey, 1988: 207) and about their ability to exploit their railroad system to overwhelm Austrian forces in the field (Bueno de Mesquita & Lalman, 1992: 229–230). But while Defender (i.e., Austria) may have lacked information, it seems safe to suggest that Challenger (i.e., Prussia) did not.

We have already shown that, in the Asymmetric Escalation Game, limited conflicts between such approximately equal players do not rationally occur when information about preferences is common knowledge. But what about the more realistic case of incomplete information? Does uncertainty about preferences make limited conflicts possible and, if so, when?

To answer this question, we now postulate players with probabilistic rather than certain information about each other's type. In other words, we assume that the players are uncertain about each other's preferences over precisely those critical outcomes that establish threat credibility. Challenger's and Defender's uncertainty about each other's preferences inordinately complicates both players' decisions, and makes behavior hard to predict.

We continue to use a discrete game model to represent the players' utilities for these problematic outcomes. By lumping all those Challengers who prefer EE to DE into the type Hard, and all others into the type Soft, we need consider only two categories of Challenger. Similarly, we require four types of Defender.

Specifically, we model behavioral uncertainty by assuming that the utility to Defender of outcome DD, D_{DD}, and the utility to both players of outcome EE, C_{EE} and D_{EE}, are binary random variables (indicated by upper case letters) with known distributions. We have previously analyzed (Zagare & Kilgour, 2000: Appendix 8) the Asymmetric Escalation Game when these random variables satisfy:

$$C_{\text{EE}} = \begin{cases} c_{\text{EE}^+} \text{ with probability } p_{\text{Ch}} \\ c_{\text{EE}^-} \text{ with probability } 1 - p_{\text{Ch}} \end{cases}$$

$$(D_{\text{DD}}, D_{\text{EE}}) = \begin{cases} (d_{\text{DD}^+}, d_{\text{EE}^+}) & \text{with probability } p_{\text{HH}} \\ (d_{\text{DD}^+}, d_{\text{EE}^-}) & \text{with probability } p_{\text{HS}} \\ (d_{\text{DD}^-}, d_{\text{EE}^+}) & \text{with probability } p_{\text{SH}} \\ (d_{\text{DD}^-}, d_{\text{EE}^-}) & \text{with probability } p_{\text{SS}} \end{cases}$$

where c_{EE^+}, c_{EE^-}, d_{DD^-}, d_{DD^-}, d_{EE^+}, and d_{EE^-}, are fixed numbers satisfying

$$c_{\text{DC}} > c_{\text{SQ}} > c_{\text{ED}} > c_{\text{DD}} > c_{\text{EE}^+} > c_{\text{DE}} > c_{\text{EE}^-},$$

$$d_{\text{SQ}} > d_{\text{DE}} > d_{\text{DD}^+} > d_{\text{DC}} > d_{\text{DD}^-} > d_{\text{EE}^+} > d_{\text{ED}} > d_{\text{EE}^-}.$$

To capture uncertainty, the type probabilities are assumed to satisfy

$$0 < p_{\text{Def}} < 1, 0 < p_{\text{HH}} < 1, 0 < p_{\text{HS}} < 1, 0 < p_{\text{SH}} < 1, 0 < p_{\text{SS}} < 1,$$

$$\text{and } p_{\text{HH}} + p_{\text{HS}} + p_{\text{SH}} + p_{\text{SS}} = 1.$$

Thus our model of the *Asymmetric Escalation Game* with incomplete information (Zagare & Kilgour, 2000) assumes that each player knows its own type, but does not know the opponent's. Defender believes Challenger to be Hard (i.e., to prefer outcome EE to outcome ED) with probability p_{Ch} and Soft (i.e., to prefer outcome ED to outcome EE) with probability $1 - p_{\text{Ch}}$, and both players know this. Similarly, Challenger is uncertain about which of the four possible types of Defender it is playing, but believes Defender to be of type Hard/Hard with probability p_{HH}, Hard/Soft with probability p_{HS}, Soft/Hard with probability p_{SH}, and Soft/Soft with probability p_{SS}, and again, both players know this.

The probability that Defender's first-level (tactical) threat is credible is then denoted by $p_{\text{Tac}} = p_{\text{HH}} + p_{\text{HS}}$; thus, $1 - p_{\text{Tac}} = p_{\text{SS}} + p_{\text{SH}}$ is the probability that Defender's first-level threat is non-credible. Similarly, Defender's second-level (strategic) threat is credible; i.e., Defender is of type HH or type SH with probability $p_{\text{Str}}=p_{\text{HH}}+p_{\text{SH}}$.

For purposes of illustration, however, our analysis in Zagare and Kilgour (2000) is not very convenient. First, four independent parameters are necessary to describe the credibilities of both players (p_{Ch}, p_{HH}, p_{HS}, and p_{SH}), which means that the credibility configuration cannot be illustrated conveniently in two dimensions. Second, the analysis splits into several cases depending on whether particular relationships are satisfied by the payoff parameters, so that even if the credibilities are completely specified, there may be several different sets of equilibria.

Here we take a different tack to make it possible to illustrate our conclusions about the Asymmetric Escalation Game and, in particular, about whether and when limited conflict is possible. First, we assume that all of Defender's credibilities are determined by a single parameter, p, satisfying $0 < p < 1$, according to

$$p_{\text{HH}} = p^2, \quad p_{\text{HS}} = p(1-p), \quad p_{\text{SH}} = p(1-p), \quad p_{\text{SS}} = (1-p)^2.$$

Note that Defender's credibilities always sum to 1, as required. In addition, it turns out that $p_{\text{Str}} = p_{\text{Tac}} = p$. In fact, identical relations can be can be derived from the following model: Determine Defender's first-level credibility by tossing a coin with probability p of H (and probability $1 - p$ of S); then determine Defender's second-level credibility by again tossing the same coin. In general, Defender is almost sure to be Soft/Soft when p is near zero; when p is near one, Defender is almost sure to be Hard/Hard; for central values of p (around 1/2), all four types of Defender are roughly equally probable.

We emphasize that we have chosen this method of representing Defender's credibilities in order to ease the representation of the equilibria and their zones of existence. We do not have in mind any empirical justification for modeling the determination of Defender's preferences in this way; this is a plausible model, perhaps, but our main motivation is simply ease of illustration. Readers who require all the details should refer to Zagare and Kilgour (2000).

A second simplification that we make here for illustrative purposes is to take specific numerical values for all of the players' utility parameters. These are as follows:

$$\begin{aligned} &c_{\text{DC}} = 100, \quad c_{\text{SQ}} = 60, \quad c_{\text{ED}} = 45, \quad c_{\text{DD}} = 40, \quad c_{\text{EE}^+} = 25, \\ &\quad c_{\text{DE}} = 20, \quad c_{\text{EE}^-} = 0; \\ &d_{\text{SQ}} = 100, \quad d_{\text{DE}} = 90, \quad d_{\text{DD}^+} = 60, \quad d_{\text{DC}} = 50, \quad d_{\text{DD}^-} = 40, \\ &\quad d_{\text{EE}^+} = 30, \quad d_{\text{ED}} = 20, \quad d_{\text{EE}^-} = 0. \end{aligned}$$

These values represent a typical case, one that makes the illustrations reasonably clear.

Perfect Bayesian Equilibria

In a game of incomplete information, rational behavioral possibilities are included in the set of perfect Bayesian equilibria, the natural extension of the subgame-perfect equilibria.[7] Note that a perfect Bayesian equilibrium specifies a choice of action for every type of both

[7] A perfect Bayesian equilibrium consists of a complete plan of action (i.e., a strategy) for each player, plus a set of beliefs for that player about the opponent's type, such that each player (1) always acts to maximize its expected utility given its beliefs, and (2) always updates those beliefs rationally given the actions it observes during play.

players at every node of the game tree; in the Asymmetric Escalation Game, this means both types of Challenger (Hard or Soft) at nodes 1, 3a and 3b, and for all four types of Defender at nodes 2 and 4.

Several of these choices are strictly determined by players' types. Specifically, Hard Challengers, preferring EE to DE, always escalate at node 3b, while Soft Challengers, with the opposite preference, always concede. At Node 4, Defenders of types HH and SH, preferring EE to ED, always choose E, while type SS and HS Defenders choose D. Finally, Defenders of types SS or SH never respond-in-kind (i.e., choose D) at node 2. The net result is that in the Asymmetric Escalation Game with incomplete information (Figure 1), a Perfect Bayesian equilibrium can be expressed as a 12-tuple of probabilities ($x_H, x_S; w_H, w_S; q_{HH}; y_{HH}, y_{HS}; z_{HH}, z_{HS}, z_{SH}, z_{SS}; r$), where:

x_H	=	probability that a Hard Challenger initiates at node 1
x_S	=	probability that a Soft Challenger initiates at node 1
w_H	=	probability that a Hard Challenger escalates at node 3a
w_S	=	probability that a Soft Challenger escalates at node 3a
q_{HH}	=	Challenger's updated probability (belief) that Defender is of type HH, given that Defender chooses D at node 2
y_{HH}	=	probability that a Defender of type HH responds-in kind at node 2
y_{HS}	=	probability that a Defender of type HS responds-in kind at node 2
z_{HH}	=	probability that a Defender of type HH escalates at node 2
z_{HS}	=	probability that a Defender of type HS escalates at node 2
z_{SH}	=	probability that a Defender of type SH escalates at node 2
z_{SS}	=	probability that a Defender of type SS escalates at node 2
r	=	Defender's updated probability (belief) that Challenger is Hard, given that Challenger chooses D at node 1.

In Zagare and Kilgour (2000: Appendix 8), all perfect Bayesian equilibria of the Asymmetric Escalation Game are determined. Table 1, reproduced from that source, lists all the 12-tuples of probabilities that can represent equilibria.[8] The various equilibria (the rows of Table 1) can be usefully organized into four groups: *Deterrence*, *No-Response/No-Limited-Response*, *Constrained Limited-Response*, and *Escalatory Limited-Response*.

Not all of the equilibria in Table 1 can occur in the example we currently examine, which has only two belief parameters, p and p_{Ch}, and numerical values for all payoff parameters. However, most of them do occur, and they occur under conditions that exemplify the existence conditions in the general case. Figure 2 shows the regions of existence of all possible perfect Bayesian equilibria in the example. Again it is convenient to show each of the groups in a separate diagram. With two exceptions, (Det_1 and Det_2, and $ELRE_4$ and $ELRE_6$) the equilibria in each group never co-exist; however, it is quite common for equilibria from several different groups to exist simultaneously.[9] With this in mind, we now proceed to a discussion of the equilibria in each of the groupings.

Deterrence Equilibria are equilibria at which Challenger never initiates. Therefore the outcome is always the *Status Quo*, SQ. Clearly, limited conflicts never occur when a deterrence equilibrium is in play. As shown in Figure 2a, one of the three Deterrence

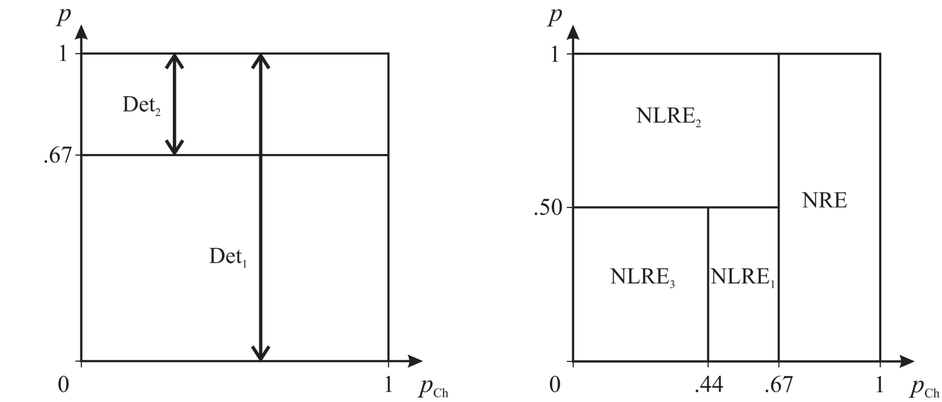
[8]The description of all possible equilibrium behavior patterns in Table 1 requires many symbols. Fortunately, the precise definitions of most of the symbols are not necessary for the purposes of this article. There is, however, one quantity that is important in categorizing and interpreting the equilibria. This quantity, which is denoted $p_{Str|Tac}$, represents the conditional probability that Defender is Strategically Hard, given that Defender is Tactically Hard.

[9]Below we comment on the significance of the co-existence of equilibria.

TABLE 1 Perfect Bayesian equilibria of asymmetric escalation game with incomplete information

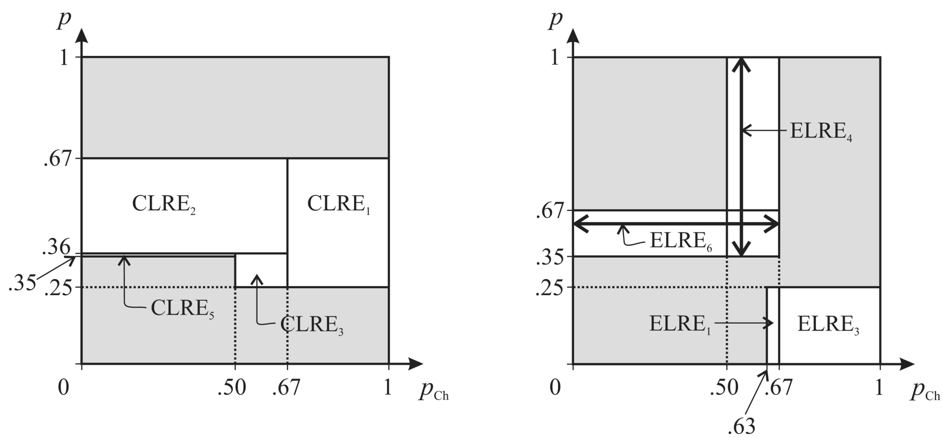
	Challenger					Defender						
	x		w			y		z				
	x_H	x_S	w_H	w_S	q_{HH}	y_{HH}	y_{HS}	z_{HH}	z_{HS}	z_{SH}	z_{SS}	r
Det_1	0	0	1	1	$\leq c_r$	0	0	1	1	1	1	$\leq d_1$
Det_2	0	0	0	0	$p_{Str\|Tac}$	1	1	0	0	0	0	$\geq d_2$
Det_3	0	0	$h(r; d_r)$	0	c_q	1	α	0	0	0	0	$\geq d_2$
NRE	1	1	Large	Large	Small	0	0	0	0	0	0	p_{Ch}
$NLRE_1$	1	1	Large	Large	Small	0	0	1	1	0	0	p_{Ch}
$NLRE_2$	1	$f(p_{Ch}; d_2)$	Large	Large	Small	0	0	Large	0	Large	0	d_2
$NLRE_3$	1	$f(p_{Ch}; d_1)$	Large	Large	Small	0	0	1	Large	1	Large	d_1
$CLRE_1$	1	1	0	0	$p_{Str\|Tac}$	1	1	0	0	0	0	p_{Ch}
$CLRE_2$	1	$f(p_{Ch}; d_2)$	0	0	$p_{Str\|Tac}$	1	1	0	0	z_{C2}	0	d_2
$CLRE_3$	1	1	0	0	$p_{Str\|Tac}$	1	1	0	0	1	0	p_{Ch}
$CLRE_4$	1	$f(p_{Ch}; d_1)$	0	0	$p_{Str\|Tac}$	1	1	0	0	1	z_{C4}	d_1
$CLRE_5$	1	$f(p_{Ch}; d_q)$	0	0	$\frac{P_{HH} Y_{C5}}{Y_p}$	y_{C5}	1	$1 - y_{C5}$	0	1	0	d_q
$ELRE_1$	1	1	$h(p_{Ch}; d_r)$	0	c_q	1	α	0	0	1	0	p_{Ch}
$ELRE_2$	1	$f(p_{Ch}; d_2)$	$h(d_2; d_r)$	0	c_q	1	α	0	0	z_{E2}	0	d_2
$ELRE_3$	1	1	$h(p_{Ch}; d_r)$	0	c_q	1	α	0	0	0	0	p_{Ch}
$ELRE_4$	1	1	$h(p_{Ch}; d_q)$	0	c_q	$1/\alpha$	1	$1 - 1/\alpha$	0	1	0	p_{Ch}
$ELRE_5$	1	$f(p_{Ch}; d_1)$	$h(d_1; d_q)$	0	c_q	$1/\alpha$	1	$1 - 1/\alpha$	0	1	z_{E5}	d_1
$ELRE_6$	1	$f(p_{Ch}; d_t)$	$h(d_t; d_r)$	0	c_q	y_{E6}	αy_{E6}	$1 - y_{E6}$	0	1	0	d_1

Source: (Zagare & Kilgour, 2000).



(a) Deterrence Equilibria

(b) No-Limited Response Equilibria



(c) Constrained Limited-Response Equilibria

(d) Escalatory Limited-Response Equilibria

FIGURE 2 Perfect Bayesian equilibria in example.

Equilibria, Det_1, exists for all possible credibilities. But the beliefs that support Det_1 are implausible.[10] Hence it is unlikely to arise in practice, especially when p_{Ch} is large. (See Zagare & Kilgour, 2000, Appendix 8 for additional details.) On the other hand, Det_2, which exists only when p is large, is not subject to any such doubt. The third equilibrium of the Deterrence Equilibria group, Det_3, cannot arise in the example under study here.

The *No-Response/No-Limited-Response Equilibria* form the second group. Here, Challenger either always or usually initiates; Defender either does not respond or escalates—there is never a response-in-kind. In the No-Response Equilibrium, Challenger always wins—the outcome is always *Defender Concedes*—but at any No-Limited-Response Equilibrium, Defender may escalate to the higher (strategic) level. Should this happen, Challenger will counter-escalate if Hard, and back down if Soft. It should be noted that Defenders who escalate are more likely to be Hard on at least one level—only when Challenger's

[10]Specifically, under Det_1 a Defender who observes unexpected initiation must believe that Challenger is likely Soft (i.e., that r is small). In our opinion it is not unreasonable to expect that a Defender who is faced with a decision at node 2 will reach this conclusion, particularly when Defender's initial belief may have been that Challenger was probably Hard.

credibility is low and Defender's is low at both levels is there a possibility ($NLRE_3$) that a strategically Soft Defender will be drawn into an unwanted conflict at the highest level. Figure 2b shows that this behavior pattern, in which bluffing plays an essential role, is associated with credibility configurations in which both players are likely Soft.

The *Constrained Limited-Response Equilibria* constitute the third group. As shown in Figure 2c, they tend to exist for all levels of Challenger credibility, but only (in the example discussed here) for middling levels of Defender credibility. Their defining characteristic is that Challenger never escalates (at node 3a in Figure 1). Usually there is initiation, following which Defenders who are Tactically Hard always (with one small exception) respond-in-kind, and the game ends at that point. But Defenders who are Tactically Soft may react to initiation by escalating, especially if they are Strategically Hard. As shown in Figure 2c, this escalation occurs (at $CLRE_2$, $CLRE_3$, and $CLRE_5$) only when Challenger's credibility is below a threshold. (Note that $CLRE_4$ does not occur in the example under study, and therefore does not appear in Figure 2c.)

The final equilibrium grouping is the *Escalatory Limited Response Equilibria*. The defining characteristic of these equilibria is that Challenger sometimes escalates after a response-in-kind by Defender. Specifically, a Hard Challenger may escalate, although a Soft Challenger never does. As Figure 2d indicates, the equilibria of this family do not in general exist in contiguous regions. In fact, the first three form one subgroup, the next two another, and $ELRE_6$ is not close to any of the others. (In this example, $ELRE_2$ and $ELRE_5$ do not actually appear.) The first subgroup, where a limited conflict is more likely, occurs only when Challenger's credibility is very high and Defender's is low (both tactically and strategically). The second subgroup also offers the possibility of a limited conflict, but only if initiation is by a Soft Challenger (or a Hard Challenger who does not escalate later), and if Defender is Tactically Hard and Strategically Soft (or Defender is Strategically Hard but chooses to respond-in-kind rather than escalate).

The multiplicity of perfect Bayesian equilibria in the Asymmetric Escalation Game with incomplete information is particularly interesting. For any credibility configuration, a minimum of two and a maximum of six of these equilibria are possible. (This is true in general, as well as in this example.) For any particular credibility configuration, it may be possible to use equilibrium refinements (more demanding equilibrium definitions) to remove some of the competing equilibria, but we have not attempted to do so. Instead we have chosen to express the ambiguity in rational behavior within the model. Since assessing the possibility of limited conflict is our main objective, we find it noteworthy whenever equilibria that limit conflict are available. Of course, these consistent patterns of rational behavior may never arise because some other behavior pattern is established instead.

The Constrained Limited Response Equilibria, especially $CLRE_1$, offer the greatest chance of a limited conflict. In fact, there is a sense in which all equilibria consistent with limited conflict are variations on $CLRE_1$. Most of the discussion to follow will be concentrated accordingly.

The Possibility of Limited Conflict

Of the 14 non-transitional perfect Bayesian equilibria in the example game, 8 include the possibility of limited conflict, but only 1 completely precludes escalation. In this section we discuss the salient strategic characteristics of the equilibria that admit limited conflict (i.e., the *Constrained Limited-Response Equilibria*, or CLREs, and the *Escalatory Limited-Response Equilibria*, or ELREs, where the game may at least "pass through" outcome DD). We give special emphasis to $CLRE_1$—the only equilibrium where a ceiling on conflict always applies (i.e., if the game ever reaches DD, it remains there).

To this end, it will be useful to distinguish the three strategic environments under which the Asymmetric Escalation Game can be played: Defender's first level threat may be non-credible (i.e., $p_{\text{Tac}}=0$); it may be credible (i.e., $p_{\text{Tac}}=1$); or it may be partial or uncertain. In this third, most interesting and most common case, Challenger is uncertain about Defender's preference between conceding and responding-in-kind (i.e., $0<p_{\text{Tac}}<1$).

In another context, we have associated the first condition with "all-or-nothing" deployment stances, like the Eisenhower administration's "Massive Retaliation" policy, that depend exclusively upon escalatory threats to deter aggression (Zagare & Kilgour, 1993).[11] The second condition is consistent with the later "Flexible Response" policies that aim to deter aggression by credibly threatening a low-level response (Zagare & Kilgour, 1995). The third possibility, the most appropriate model for most actual extended deterrence situations, lies between the Scylla of Massive Retaliation and Charybdis of Flexible Response.[12]

It should not be surprising that in the first instance, when Defender's first-level threat is known to be non-credible, there can be no perfect Bayesian equilibrium that involves the possibility of limited conflict. To understand why, note that a Defender with a noncredible first-level threat is Tactically Soft, in the terms of our model and, as noted above, a Tactically Soft Defender cannot choose D at node 2 at any perfect Bayesian equilibrium. Thus, our model implies that limited conflicts are simply not possible under a deployment policy, like Massive Retaliation, that forgoes tactical or substrategic options.

It is perhaps more surprising that limited conflict is only slightly more likely when the credibility of Defender's substrategic threat is beyond doubt. Under conditions consistent with Flexible Response deployment policies, two Perfect Bayesian equilibria—not present when Defender lacks a credible substrategic threat—can result in limited conflict. They are the Escalatory Limited-Response Equilibria ELRE_3 and ELRE_6. Limited conflicts are in principle possible under these equilibria but, as will be explained, this possibility is remote.

As we discuss at length elsewhere (Zagare & Kilgour, 1995), Challenger is prone to initiate at Escalatory Limited-Response Equilibria. What happens next depends on Defender's type. Usually, Defender capitulates, but from time to time, with type-dependent probabilities, it either responds-in-kind or escalates. Of course, limited conflicts can occur only in the former instance.

But even when Defender responds-in-kind, the outcome is not always limited conflict: Challenger often escalates at node 3a because, in equilibrium, Challenger believes Defender is unlikely to be Strategically Hard and hence unlikely to escalate at node 4. In sum, while limited conflicts are theoretical possibilities when Defender's substrategic threat is perfectly credible, they are not high probability events.

This conclusion changes significantly, however, when Defender's substrategic threat is neither credible nor noncredible (i.e., when $0 < p_{\text{Tac}} < 1$). Five additional equilibria—the Constrained Limited-Response Equilibria—exist only when p_{Tac} lies strictly between 0 and 1. Limited conflicts are more likely to occur under a Constrained Limited-Response Equilibrium than under any other equilibrium form.[13]

At a Constrained Limited-Response Equilibrium, Defender must be fairly likely to be Tactically Soft (i.e., of type SS or SH) and, if Tactically Hard, must be likely to be

[11]Another example is British deployment policy just prior to World War I. At that time, "the British Army was a small volunteer force meant to serve as a colonial constabulary and not intended for Continental service. The fact that the British had no conscription also meant that they had no trained reserve that could be brought to bear quickly on the Western front." (Kagan, 1995: 212).

[12]For a special case analysis, see Zagare and Kilgour (1998).

[13]Four additional Escalatory Limited-Response Equilibria also arise when Challenger is uncertain about Defender's preference between outcomes DC and DD. But since these equilibria are not propitious for the emergence of limited conflict, we will not discuss them further here.

Strategically Hard also. Challenger always initiates if Hard, and generally initiates if Soft. If it is Tactically Hard, Defender generally responds-in-kind. While it normally capitulates if Tactically Soft, it may sometimes escalate if it happens to be Strategically Hard also. Thus, rational behavior under a Constrained Limited-Response Equilibrium may have many outcomes, including a low cost victory for Challenger (i.e., DC); *Limited Conflict* (DD) is also a distinct possibility.

What conditions are required for this outcome? One necessary condition is that Defender is actually Tactically Hard—as noted above, Tactically Soft Defenders never choose D at node 2. If Defender is Tactically Hard, it almost always responds-in-kind. Another equilibrium requirement, however, is that this choice surprise Challenger, who initiated in the hope that Defender was Tactically Soft. Then, caught by surprise, Challenger reassesses its original estimate of Defender's type. Knowing that Defender must be either of type HS or HH, it must now conclude that Defender is very likely to be Strategically as well as Tactically Hard, i.e., of type HH. For this reason Challenger *never* escalates at node 3a when a Constrained Limited-Response Equilibrium is in play. Unlike other equilibrium forms, then, limited conflicts that occur under a Constrained Limited-Response Equilibrium *always* remain limited.

While not the ordinary stuff of international relations, behavioral sequences similar to what was just described may not be so unusual. For example, in 1898 France quickly backed down from its plan to take control of the upper Nile when Britain unexpectedly resisted at Fashoda. Similarly, in 1948, the unforeseen resistance of the Western allies eventually prompted the Soviets to drop their blockade of Berlin. And in 1962, the Soviet Union, apparently surprised by the severity and suddenness of the U.S. "quarantine," agreed to withdraw its missiles from Cuba. In each of these cases, Challenger adjusted its actions in response to a signal that it interpreted as a warning of Defender's commitment, thereby tempering a potentially dangerous conflict.

Much the same could be said of British and French behavior during the Suez crisis of 1956, except that in this case the credible signal came from an ally—the United States. In October, a few months after Egyptian President Nasser nationalized the Suez Canal, Britain and France, acting in concert with Israel, invaded Egypt. The Soviet Union threatened nuclear retaliation unless forces were withdrawn. Nonetheless, it was likely the negative reaction of the United States, with indications of additional diplomatic costs if President Eisenhower and Secretary of State Dulles were further alienated, that convinced Britain and France to pull back from the canal (Snyder & Diesing, 1977: 444).

Summary and Conclusions

In this article, we use a discrete game model to analyze a prototypical escalation problem, permitting us to ask whether limited conflicts are possible and, if so, when. In the Asymmetric Escalation Game with incomplete information, one player, Challenger, decides whether to initiate a conflict. If Challenger initiates, the opponent, Defender, decides whether to capitulate or to respond, and if the latter, whether to respond-in-kind or to escalate. If Defender responds, Challenger can escalate. The process continues until one player decides not to respond, or until both players have escalated to the highest (second) level.

Of course, this game presumes a hostile strategic relationship between the players. Challenger, for instance, has an immediate incentive to upset the status quo by initiating a conflict; and both players prefer to escalate provided the other does not counter-escalate. But both have interests in common as well—for example, both prefer to minimize conflict.

Conflicts—limited or all-out—are not possible in the Asymmetric Escalation Game with complete information. Either deterrence succeeds and the status quo prevails, or deterrence fails and Defender capitulates. No other outcomes can occur.

By contrast, a wide range of outcomes is possible in the Asymmetric Escalation Game with incomplete information. When the players are uncertain about crucial preferences of the opponent, limited conflicts can occur, but not necessarily. The perfect Bayesian equilibria of the Asymmetric Escalation Game with incomplete information were described briefly, and a numerical example was used to illustrate the connection between the players' threat credibilities and likely behavioral sequences.

In the austere strategic environment underlying our analysis, conflicts are most likely to be limited under a Constrained Limited-Response Equilibrium, which requires Challenger to be unsure about Defender's willingness to respond-in-kind after initiation. (Limited conflicts are possible but unlikely under an Escalatory Limited-Response Equilibrium.) The primary conclusion from the model is that limited conflicts that arise between two motivated and capable adversaries will probably involve miscalculation in the sense that the initiator will be surprised by an unexpected response.

To be somewhat more specific, we find that a necessary condition for a conflict to begin—but not to escalate—is that Challenger's prior beliefs about Defender be such that Defender can use a tactical-level response to signal that it is prepared to respond further. According to our model, the requirement of a high conditional probability that Defender is strategically Hard, given that it is tactically Hard is necessary but not sufficient for limited conflict to be possible. By interpreting tactical responses as signals, this finding clearly suggests that war is indeed "politics by other means."

To elaborate, consider the behavior of the United Nations (UN) Command in Korea after the landing at Incheon in 1950, behavior that both Lampton (1973: 28) and de Rivera (1968: 53) point to as an example of how cognitive and other extra-rational factors adversely affect crisis decision-making. Despite unambiguous warnings from China that it would become involved in the conflict, UN forces proceeded past the 38th parallel, believing Chinese intervention to be unlikely. But when this unlikely event occurred, the UN command suddenly reexamined its war aims. Within days, Secretary of Defense George Marshall decided to "use all available political, economic and psychological action to limit the war" (quoted in Gacek, 1994: 57).

Lampton and de Rivera have a point: conceptual blinders and cognitive rigidity may play a role in establishing beliefs and, hence, in defining a game. But this does not necessarily imply irrationality, as these authors suggest. Given the pattern of its beliefs, the UN decision to proceed *and* its subsequent choice not to further escalate the conflict are consistent with rational behavior under a Constrained Limited-Response Equilibrium.

While our analysis provides a deeper understanding of the conditions under which limited conflicts might occur, we are—as yet—unable to specify exactly when they will occur. In other words, the existence of a Constrained Limited-Response Equilibrium or a Escalatory Limited-Response Equilibrium constitutes a necessary but not a sufficient condition for sub-strategic conflicts. There are two reasons for this. First, under either equilibrium form, other outcomes—including all-out conflict—are possible. And second, neither equilibrium form is unique: each always co-exists with another equilibrium form that precludes the possibility of a limited conflict.

In closing, we note that the escalation game we postulate is rather inimical to peace. Challenger always has an immediate incentive to upset the status quo, so it should not be surprising that under all the equilibrium forms we identify except Deterrence, Hard Challengers always initiate conflict and Soft Challengers frequently do the same. On the other hand, each player in our model is presumed to possess retaliatory threats that are capable: the opponent prefers not to experience them. This assumption, perforce, rules out limited conflicts, such as the Austro-Prussian War of 1866, that occur because one actor actually prefers them to the status quo. Because it ignores this possibility, our analysis understates the possibility of substrategic conflict. Nonetheless, our model helps to shed light on the possibilities for limited conflicts under the most difficult and problematic set of circumstances.

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