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A Theory of Binary Crises

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1. Introduction

In this paper I present a new theory of binary crises which can be fully formalized and thus may serve as a basis for model based computer implementations. By operating on a suitable level of abstraction the model yields a comprehensive yet relatively simple picture of a crisis as a certain pattern of interplay of perceptions and choices of plans by different groups. This general model can be specialized in different ways to capture concrete forms of crisis interactions. I describe such possibilities all the way down to concrete computer applications.

The method according to which the model is constructed differs from established Operations Research (OR) approaches. Whereas the latter describe a system in terms of numerical variables and dynamical equations of these my approach is along the lines of Artificial Intelligence (AI) in which symbolic representation is no longer focused on real numbers but may as well be achieved in terms of formal sentences. Roughly, the role of numbers is taken over by syntactical expressions, and numerical calculations are replaced by the manipulation of syntactic entities. The resulting models are not only discrete in time; they are purely qualitative in the sense of not referring to real numbers at all. Thus in applications the encoding of 'real-life' entities by real numbers, or their 'measurement' can be avoided.

¹The theory presented here was developed under DFG project Ba 678/4-1 during 1989 - 1992. I am very much indebted to my collaborators in that project, A. Gayhoff and J. Sander who contributed to the development of the theory in substantial ways.

The model is based on a proposition component representing the frame of language used by the actors, and a plan component representing the relevant goals and plans. The actions of decision groups are captured by describing how they perceive their environment (their ‘realities’) and how they choose and delete plans. The comprehensive picture characteristic for crisis development is described as a planning cone representing the feature that both groups’ ranges of alternative courses of actions become more narrow over time. This narrowing is mainly due to narrowing perceptions and to alternative plans becoming impossible. In a full crisis the planning cone converges: it has a sharp point at which only plans including the use of force are left as alternatives.

On the basis of this general model the different forces or causes may be studied which lead to that kind of convergence. In special cases it is possible to characterize ‘initial states’ as states from which a convergent development will originate. The identification of such states is of utmost importance for application. If an initial state is reached a crisis is unavoidable, and in order to prevent a crisis it is necessary to avoid at least those initial states which are visible in the model. In ‘brinkmanship crises’, for instance, the parties involved may see the risk of reaching a state in which violence cannot be avoided any more, but they may not be clearly aware of the nature of such a state nor of the moves which will bring them there.

In Sec. 1 the general model is presented, including four central hypotheses. In Sec. 2 the importance of perception is stressed and I show how perception can be represented. In Sec. 3 the notion of conflicting plans is defined, and in Sec. 4 patterns emerging from linkage between plans, goals and commitments are described. In Sec. 5 a particular topology is introduced to fix the notion of convergence of a planning cone. Sec. 6 briefly deals with other salient features: institutions, decision making, the international system, and Sec. 7 addresses the way of applying the theory by discussing a concrete crisis. Sec. 8 contains a brief comparison with other approaches.

2. The Core Theory of Binary Crises

The core theory and its corresponding core models cover the ‘ideal’ case of a binary crisis which ends in violence. It represents a precise, general

framework which can be specialized in several different ways to yield different patterns or types of crisis development. Weaker forms in which the crisis is resolved before fighting begins, as well as some of the special patterns will be presented in Sections 4 and 5 below. I first describe theory's vocabulary, and then use this in order to formulate its general hypotheses.

2.1 Vocabulary

The notions needed in order to formulate the model are the following:

- *Propositions.* In the present context I regard a proposition simply as a sentence, like 'We threat (blockade, attack ...) them', 'We want to prevent them from invasion (attack, ...)', 'Our goal is to capture the island', 'We believe that they chose plan p ', or 'Nation's security is threatened'.² A set A of propositions provides the means to describe various kinds of actions and states of affairs of different levels of abstraction. I assume a weak, 'minimal' structure on propositions: they should form a *poset* with complement. Thus there is a relation \preceq among propositions which I read as 'meaning-implication', and an operator \neg which I read as 'negation'. The structure of a poset is weak enough to allow for 'to launch a military attack' implying (by meaning, not logically) 'to put some military units into operation', or 'to sign a treaty' to imply 'to have written versions of the treaty at hand'.³
- *Plans.* A plan is, very roughly, a structure of 'atomic' actions which are linked to each other causally and in time in the right way. I will not go into any details but only introduce three components of a plan p which will be needed in the following.⁴ These are: p 's goal, $goal(p)$, p 's set of conditions, $conditions(p)$, and p 's set of initial

²More formally, a proposition is a set of sentences (perhaps from different languages) all of which have the same meaning. Though philosophically contested (Schiffer, 1987) this notion has proved rather useful in the social sciences.

³In applications the set of propositions may easily be structured in more sophisticated ways. For instance, we may superimpose a classification of propositions according to any given schema like that of (Brecher, 1977) or (McClelland, 1968) or a more general one in the spirit of (Ballmer & Brennenstuhl 1981).

⁴There is a rich literature on plans and plan based reasoning in AI. In connection with the present model, a suitable notion is presented in (Sander, 1993).

conditions, *inicons*(p). Goal, conditions, and initial conditions can be described by means of propositions. Conditions are those atomic actions or states of affairs which ‘occur in’ the plan and have to be performed or to be true if its execution is to proceed. Initial conditions are those conditions which are assigned to the first point of time in the plan’s execution.

- *Groups*. There are just two groups G, G' in a binary crisis. These are not analyzed internally nor in their psychological, social, and institutional setting. They are taken as ‘corporate actors’ who perceive and decide as unseparable units.
- *Beliefs*. Each group perceives its environment and forms beliefs about it which are expressed by means of propositions. Those propositions which the group believes are true⁵ are put together to form a set $\{a_1, \dots, a_n\}$ denoted by *real*(G) and called ‘ G ’s reality’. This notion captures the actions and states of affairs as *perceived by* G , no ‘objective’ points of reference are assumed.
- *Choice*. Groups can choose plans and give them up. Such choice involves decision but decision itself is not included in my model.⁶ The basic feature of choosing a plan is a commitment to execute it once its initial conditions are satisfied. As long as the *inicons* of p are not true p may be chosen, but not executed. This is quite normal. There are emergency plans which will be nearly automatically activated under specified, special conditions, and thus are chosen at any time. Usually, a group has chosen many different plans at a time which may be more or less rationally linked to each other. The set $\{p_1, \dots, p_m\}$ of all plans chosen by group G I denote by *choice*(G). A new plan’s being chosen or a previous plan’s being given up then can be modelled by inserting it in, or deleting it from, *choice*(G).
- *Time*. I assume a simple time structure consisting of an infinite set T of points of time, linearly ordered by \leq , which does not have a greatest element. In reality, a ‘point’ of T will usually be a short

⁵For reasons of simplicity I avoid degrees of belief which involve a probabilistic setting with all the known problems of adding up beliefs.

⁶See Sec. 6 below.

period. Beliefs and choice now can be made dependent on time, and I write $real_t(G)$, resp. $choice_t(G)$ to denote what G believes to be true resp. has chosen at time t . Reference to points of time also must be allowed in the propositions themselves, and, of course, in the descriptions of plans. With respect to a given set of propositions and G 's reality we can say that a plan p is impossible for G at time t , if, for any instant $t' \geq t$, some condition of p contradicts (in the sense of \preceq and \neg) to what is believed at t to be true at the later time t' .

- *Crash plans* are plans involving the use of force. Every crash plan is a plan.
- *Crisis goals*. These are specific goals which keep the crisis going as long as they are pursued, and will be defined in hypothesis H2 below.
- *Links* of plans to 'external' goals. A plan p may be linked to a goal which is not p 's goal. This will turn out as a central, 'theoretical' term which can be specified in several different ways (see Sec. 4).
- *Closeness* as a notion borrowed from topology. In a topological space one can say that two 'points' are close to each other in the sense that one of it belongs to a neighbourhood of the other. Such a technical notion will be used as applying to lists of sets of propositions and is defined in Sec. 5.

With these concepts a minimal crisis kinematics can be introduced describing the development of a crisis over time by a sequence of states of the form

$$s_t = \langle real_t(G), choice_t(G), real_t(G'), choice_t(G') \rangle$$

where t runs through the set T of instants. Such a sequence I call a *development*. Depending on the choice of T a development may include periods well before and after the crisis, or just a part of it, or - if T is well chosen - exactly the relevant process which with hind-sight is termed 'the' crisis. Each state thus comprises information about what both groups believe to be true and about the plans they have chosen at a certain time. A development can describe very different kinds of real processes, no features of crisis need to be present.

The sequence

$$(\langle \mathit{real}_t(G), \mathit{choice}_t(G), \mathit{real}_t(G'), \mathit{choice}_t(G') \rangle)_{t \in T}$$

is called the *planning cone* (of the system or the crisis).⁷

2.2 Hypotheses

As a first approximation, I distinguish between two kinds of developments: normal ones and converging ones. The idea is that a development capturing a crisis converges, or tends to converge, in a sense to be made precise, whereas a normal development does not have this property. The ‘limit’, to which a crisis development converges is essentially given by a pair of crash plans, and the limit is reached when the groups begin to execute these crash plans. In the following, I will spell out the nature of the special kind of convergence that applies here. As noted above strict convergence holds only in the ‘ideal’ case when the crisis ‘ends’ in the execution of force.

As a second approximation, it will be helpful to imagine the sets of plans occurring in a planning cone as having a varying degree of ‘horizontal extension’. A pair $\langle \mathit{choice}_t(G), \mathit{choice}_t(G') \rangle$ may be depicted by a line as shown in Fig. 1 for different instants t_1, \dots, t_4 , the left hand part of the line representing $\mathit{choice}_u(G)$ and the right hand part, doubly drawn, $\mathit{choice}_u(G')$.

In a convergent development these sets become ‘smaller’ over time, and the image of a cone emerges. Neglecting the sets $\mathit{real}_t(G), \mathit{real}_t(G')$ for a moment, full convergence obtains when the planning cone ends up at the top with just two plans left which are crash plans. There might be more than one crash plan involved, and usually it is sufficient that one group’s sequence $(\mathit{choice}_t(G))_{t \in T}$ converges, for in the normal case this will lead to the other group’s execution of a crash plan, too.

Put verbally, the point in a convergent development is that the sets of chosen plans become smaller over time because chosen plans get eliminated. In the end one party is left only with a crash plan.

There are two basic kinds of causes that lead to such a narrowing of the set of chosen plans. From a group’s own side there are causes like narrowing perceptions, isolation, stress, frustration, physical exhaustion,

⁷The label will become clear at once.

and from the enemy's side the causes basically consist of successful attempts to eliminate plans by making them impossible.⁸ There are different patterns here which in isolation or in conjunction lead to convergence, and the core model is not - and cannot - be intended to make all these patterns explicit.⁹ Rather, the core model provides a frame in which different such patterns can be analyzed and made precise.

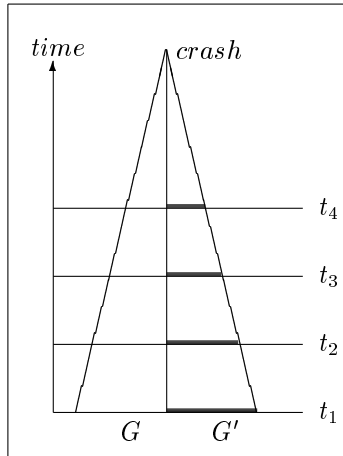


Figure 1: Sets of Plans

Yet, even without specifying these patterns much more can be said about the structure of a crisis. I will formulate four hypotheses which express what is typical for convergent developments - and thus for binary crises - at the general level. In doing so I postpone the explanation of the notion of conflicting plans to Sec. 3. The hypotheses are formulated with respect to a given development.

- H1) There is a first instant t_0 such that at t_0 the planning cone contains plans for each group which are in conflict with each other.
- H2) The goals of these conflicting plans from H1 are the crisis goals.
- H3) At each time t later than t_0 there exist plans for both groups in the

⁸Recall the definition of impossibility given above.

⁹This is impossible because different patterns are incompatible.

planning cone which are in conflict with each other and which are linked to the crisis goals from H2.

H4) The planning cone converges to a pair of crash plans.

A structure consisting of denotations of all the primitives introduced above, and satisfying these hypotheses is called a *model of a binary crisis*.

While H4 simply states that the planning cone converges, H1 - H3 in a certain sense say why this is so. Convergence obtains because there is an initial situation of conflict, a pair of conflicting plans setting the stage. The initial, conflicting plans have goals which overshadow the subsequent development and turn out as crisis goals. This is substantiated by H3: each of the subsequent states will involve conflicting plans which are linked to one of the crisis goals. The two initial, conflicting plans together with the point of time at which they first are chosen also may be called the *origin* of the crisis, and crisis prevention is concerned with singling out those pairs of conflicting plans which have the potential to become the origin of a crisis from other, more innocent, such pairs which always are present.

3. Perception

The way each group perceives its environment and, in particular, the actions, choices and beliefs of the other group, is crucial for the understanding of political phenomena. This is general wisdom in crisis research, and I want to stress that the present model accomodates for perceptions. Both groups' realities $real(G), real(G')$ are perceived realities, the propositions in these sets represent actions and states of affairs (I subsume beliefs and choices under 'affairs') as perceived by each group.

Due to the expressive power of propositions we may easily make explicit the dependence on perception. Let $a \in A$ be a proposition. By writing $[a]_G$ I denote the proposition that a represents an action or a state of affairs *as perceived by G*. Now nothing prevents us¹⁰ from assuming that among the propositions there occur propositions of the form $(p \in choice_t(G')), g \in real_t(G), (1) [p \in choice_t(G)]_{G'}, (2) [a \in real_t(G')]_G,$

¹⁰I think that objections pointing out circularity can be rejected but the presentation of an argument is beyond the scope of this paper. These kinds of circularities can also be found at the foundations of modern science, for instance in the foundations of classical analysis involving impredicative, logical systems.

(3) $([p \in \text{choice}_t(G')]_G \in \text{real}_t(G))$, (4) $([a \in \text{real}_t(G)]_{G'} \in \text{real}_{p'}(G))$ etc. (1) expresses that, from the perspective of G' , group G has chosen p at T , (2) expresses that, as perceived from G , the group G' believes that a is true. (3) states that G at t believes that G' 's choice of p at t as perceived by G is correct. Put in ordinary terms: G believes that G' has chosen p at t . In the latter formulation the explicit reference to G' 's perception is lost, though. Similarly, (4) states that G believes at t that, from G' 's point of view, G believes in a at t . These relatively simple examples should be sufficient to show that all kinds of perceptions can be expressed in a similar way.

I will suppress this kind of formal notation in the following and use formulations in ordinary language but with the understanding that things can be made precise as just shown.

4. Conflicting Plans

This notion was already used in formulating H1 and H2, but as it involves matters of perception, its definition was postponed. The notion of two propositions (or goals) contradicting each other was already introduced. The 'complementary' notion of compatibility is defined in an analogous way. Two propositions are *compatible* if neither implies (by meaning) the negation of the other. This notion may easily be extended to sets of propositions. Two sets A and B of propositions are compatible if any two elements from each of them are so. I write $A \text{ com } B$ to express this.

Consider now an instant t and two plans p, p' . I will propose several conditions which have to be satisfied jointly in order to say that p and p' are in conflict. As a general presupposition which is satisfied in any application I assume:

- 1) p and p' are chosen by G and G' at t , respectively. Also, each plan should be feasible in the sense that all its conditions are compatible with the respective group's beliefs.
- 2) $\text{conditions}(p) \text{ com } \text{real}_t(G)$ and $\text{conditions}(p') \text{ com } \text{real}_t(G')$.
- 3) Each group believes that the other group chose 'its' respective plan

at t .¹¹ If, say, G does not believe that G' has chosen p' , there is no conflict.

4) Each group G believes that the other group's chosen plan is feasible.

Here, perspective makes a difference. What is really needed is feasibility as perceived by the group G in 4). If G believes that, from G 's perspective the plan p' chosen by G' is not feasible, no conflict is likely to arise. The second alternative in which feasibility is seen from G' 's perspective does not seem to be necessary for conflict. G may well believe that G' thinks p' to be feasible, but as long as G is not itself convinced of this feasibility, the plan p' is not likely to cause nervous reactions.

5) Both plans' goals contradict each other.

This is a crucial condition, and needs no further justification. Next, both plans should be immediately relevant in the sense implied by the meaning of choice. As already noted, a chosen plan whose *inicons* are realized (= believed to be true) will be executed. So a plan is immediately relevant if its *inicons* are realized.

6) $inicons(p) \subseteq real_t(G)$ and $inicons(p') \subseteq real_t(G')$.

Finally, this kind of immediate relevance should be perceived on both sides.

7) Each group G believes that the other group's plan is immediately relevant. Again, immediate relevance here is necessary only as perceived from the group G in 7).

Each of these conditions can be seen to be necessary for conflict by providing counterexamples in which a condition is not satisfied, and in which conflict is unlikely to arise. On the other hand, I do not see further necessary conditions which can be formulated in the present vocabulary, and in this situation I propose to take the conjunction of 1) - 7) also to be sufficient for conflict. So I say, that two plans are *in conflict* (for G, G') at t if 1) - 7) are satisfied.

¹¹ Compare Sec. 2.

5. Plans Linked to Goals

Often, a plan's goal is instrumental to achieve another, more important goal which is 'external' to the plan, and the plan is carried out as one step of reaching that external goal. As the web of plans, goals and their being instrumental for each other is very complicated I use the notion of a link as an umbrella term to cover all kinds of a plan's relations to external goals. In H3 this notion is used to make sure that the crisis goals are pursued after the origin by requiring the presence of conflicting plans which are linked to crisis goals. As pointed out, there are different patterns of how a crisis may develop in the frame set by H1 - H4, and these patterns are heavily dependent on the ways in which plans get linked to each other. Here are some basic forms of how a plan p for group G may be linked to an external goal g .¹²

1) g may be the goal of another plan p_1 chosen by G such that $goal(p)$ is a condition of p_1 .

2) Links of type 1) may occur in iteration. These types of links are present in the context of H3 when various 'subplans' chosen to achieve the crisis goal just aim at satisfying ever more conditions of the original plan chosen at the origin which arose conflict. The pattern coming up here is that of rather comprehensive crisis goals whose achievement involves various, 'local', conflicting plans.

3) There may be a plan p' chosen by the enemy which is in conflict with p such that $goal(p)$ consists of the negation of one of p' 's conditions. Note that perception is important here.

4) Links of type 3) may occur in iteration where iteration can take place on one side, or 'back and forth'. $goal(p)$ may negate a condition of p' which, by G , is seen as a subplan necessary for the enemy to carry out another chosen plan p'_1 . Or $goal(p)$ negates a condition of the enemy's potential plan p' by which the enemy could itself negate a condition of one of G 's important plans p_1 . Obviously there is a large variety of possibilities here, depending on which plans are seen as chosen or not, and on the different possibilities created by perception. Less obvious, but very important is the effect of such links in an actual development

¹²Of course each plan of G is linked to its own goal in a trivial sense.

which leads to a second, general pattern. If a plan p linked to goal g in one of the ways 3) or 4) is carried out this will lead to the elimination of the ‘target plan’ on the other side which has become impossible now. If a group comes to believe that a chosen plan has become impossible because one of its conditions was negated by the enemy then, assuming a certain amount of rationality, it will eliminate the plan from its set of chosen plans. Such kind of elimination accounts for a large proportion of the narrowing of planning cones necessary for convergence. The pattern associated with such links becomes relevant when both groups have many plans to eliminate plans on the other side by negation of their conditions which is usually possible in the military domain.

Further types of links are established by explicit or implicit commitments. Group G may have committed itself to choose a plan p_1 once the other group chooses a contested plan p' ; I write $commit(G, p | p')$ to express this. 5) If $commit(G, p | p')$ and G believes that G' has chosen p' then a fifth type of link is established: for G , p is linked to $goal(p')$. 6) A link can be given by chains of commitments of the form 5). If, for instance G deliberates to choose p , and there are commitments $commit(G', p' | p)$ and $commit(G, p_1 | p')$ perceived by G then, for G , p is linked with $goal(p_1)$. Again, there is a great variety of possibilities here, and corresponding patterns leading to the choice of crash plans on the basis of commitments.

6. Convergence

The notion of convergence presupposes a topological notion like neighbourhood, or distance. A sequence converges to a ‘point’ u if, very roughly, the elements of the sequence get ever closer to u , their distance from u goes to zero. The sequences considered here are sequences of states, so a topology has to be introduced on the set of all possible states. This set is well defined if we assume given sets of propositions and plans from which possible states can be constructed. In the frame used here there are several possibilities of introducing a topology on the set of all states, one of which I will describe in detail.

One standard way of defining a topology is to define a ‘system of neighbourhoods’, that is, to define for every ‘point’ (= state in the present frame) a set of neighbourhoods of that point such that the well

known axioms for neighbourhoods are satisfied.¹³ Along this line I will define, for two given states s, s' what it means that s is in the (ϵ, k) -neighbourhood of s' . This also may be expressed intuitively by saying that the distance of s from s' is smaller than $k \cdot \epsilon$ but I will not actually use metrical concepts. Recall that a state has the form $s = \langle B_s, X_s, C_s, Y_s \rangle$ where B_s and C_s are sets of propositions (the groups' realities), and X_s, Y_s are sets of plans (those chosen by the two groups). In a first step, I replace plans by sets of propositions. Instead of talking about a plan p I will talk about p 's set of conditions: *conditions*(p); a set of plans X thus can be replaced by the joint set of all conditions occurring in the plans of X . Second, I distinguish between conditions occurring in crash plans, and conditions occurring in 'non crash' plans, that is, in plans which are no crash plans. Third, the conditions of a set of plans are evaluated in terms of what a group believes to be the case. Only those conditions are taken into account which are believed to be true. This allows, in a fourth step, to define, for a state s , two sets: $cr(s)$ and $nr(s)$ called the set of 'realized crash conditions in s ' and the set of 'realized non crash conditions in s ', respectively. $cr(s)$ contains all conditions from crash plans in X_s and Y_s which are believed to hold in one of the two groups. $nr(s)$ contains all conditions from non crash plans in X_s and Y_s believed to hold by one of the groups.

Consider two states s and s' , of which, intuitively, s' is the 'target state' whose neighbourhood is defined. In application to H4 s' might be the limit state containing only crash plans. I say that s is in the (k, ϵ) -neighbourhood of s' (k being a natural number) if the following four conditions are satisfied:

- 1) the realities B_s, C_s occurring in the target state s' are more narrow than those in s : $B_{s'} \cup C_{s'} \subseteq B_s \cup C_s$
- 2) the target state s' contains more realized crash conditions than does s : $cr(s) \subset cr(s')$
- 3) the realized crash conditions of s plus the realized non crash conditions of s' are 'fewer' than the realized crash conditions in s' plus the realized non crash conditions in s : $cr(s) \cup nr(s') \subseteq cr(s') \cup nr(s)$
- 4) the numbers of conditions by which the 'larger' side in 2) and 3)

¹³See, for instance, Schubert (1964, 2.3).

exceeds the ‘smaller’ side, are bounded¹⁴ by $k \cdot \epsilon$.

It is not difficult to show that neighbourhoods thus defined, in fact satisfy the usual axioms. By this technical move the notion of convergence has now a definite meaning. Roughly, convergence obtains when the sets of realized crash conditions in both groups’ states become larger, if the sets of realized non crash conditions become smaller, and if both groups’ realities get narrower, until in the end, all conditions of the crash plans are satisfied, and these will be carried out.

This seems pretty much idealized, but the following should be kept in mind. An infinite sequence of states may well converge very quickly, say, in 5 steps. After five steps a state may be reached which does not change any more in later steps; the sequence becomes ‘stationary’ at state number 5. According to my four hypotheses this state then must have the distinguished feature of containing, for at least one group, only crash plans. This group will start fighting and the crisis is perfect. The remaining, infinitely many states which are present in the model are redundant in such a case; they are empty, technical ‘Überbau’.

However, as the main goal of applied crisis research - at least for scientists, I think - is prevention and crisis solution. A weakening of the model is desirable in which only ‘partial’ developments of a ‘crisis-like’ kind are described. Such weakening is easily achieved. We just have to replace the infinite set of points of time by a finite set, and replace the hypothesis of convergence (H4) by some weaker version expressing that the ‘partial’ planning cone still has the form of a cone. That is, in each transition from t to $t + 1$ the states become more ‘narrow’: more crash conditions and fewer non crash condition are realized, and the realities are narrowed. Using the above terminology I define that state s' it is more narrow than state s if requirements 1) and 3) above are satisfied, and I define a partial development to consist of a finite list of states (s_1, s_2, \dots, s_n) . A *partial crisis* then can be characterized as a partial development satisfying the following:

P1) There is a first instant t_0 such that the planning cone contains plans for both groups which are in conflict with each other.

¹⁴ k is necessary in order to overcome the ‘coarseness’ of cardinalities. Another, more sophisticated approach can only be mentioned. It consists in assigning weights to the propositions and using a measure on sets of propositions to compare their ‘distances’.

- P2) The goals of these conflicting plans from P1 are the crisis goals.
- P3) At each time t , $t_0 \leq t \leq n$, for both groups there exist plans chosen at t which are in conflict with each other and which are linked to one of the crisis goals from P2.
- P4) For all $t < n$: s_{t+1} is more narrow than s_t .

7. Looking at the Real World

In real processes of international crises three additional features often are important which are not captured by the present theory. Some brief comments on these will help to clarify the present theory's position.

1. *The groups' institutional setting.* Real groups acting in a crisis are not only engaged in dealing with the enemy, they also are part of an institutional setting on their own side. Often, they are the leading group of a state, and perhaps the most salient drive motivating group members is the drive to stabilize, and expand, their leading position in this state. In the own system, such a group is exposed to opposition groups who want to take over, and to other groups who want to take influence, like media, churches, military, firms, unions, and, rarely, the population. Many decisions taken in a crisis, in particular the first decision of choosing a plan which is seen to be in conflict with a plan of the enemy, are mainly motivated by 'internal' considerations of improving the group's position in the own system.¹⁵ It is therefore necessary to extend the analysis of crises to include the 'internal' structures in which the crisis decision groups are leading groups of 'their' respective institutions. Here, the sociological investigations of social institutions and organizations can be used to enrich the picture. I have developed myself a precise theory of institutions (Balzer, 1990, 1992, 1993) which seems well-suited for this task. On my account, an institution is, very roughly, a hierarchy of groups ordered by individual power relations among the groups' members and stabilized by 'internal' models ('ideologies'). Each institution has a unique top-group the members of which are the most powerful. Crisis decision groups

¹⁵This is convincingly brought out by (Lebow, 1981).

may be fitted into this model by taking them as the top-groups of respective institutions like states or armies. The group's reality and choice function operative in the crisis model then can be seen to be strongly influenced by factors emerging in the institution.

2. *The international system and multiple crises.* At present, there are a number of international organizations affecting the course of what would otherwise be binary crises, and in many crises the 'local' opponents' behavior is steered or strongly influenced by other, more powerful groups from large states. Also, there are of course crises involving several states on an equal footing (like in the outbreak of World War One) I think that the present theory may serve as a starting point for modelling such more complex types. Basically, a multiple crisis also consists in a confrontation between two 'blocks' or coalitions, the groups in a coalition supporting each other. There are two main ways of how such coalitions can be treated along the lines of the present approach.

First, a coalition may be very tight such that the different decision groups present in the coalition work together very cooperatively, putting to the side their long term own interests for a while. Analytically, these groups then can be merged into one group. The bargaining and interaction among these groups is 'internalized', and only the joint actions and decisions are taken into account. For this approach the present model can simply be taken over - at the cost of losing information about what's going on inside the coalition(s).

A second approach seems more adequate when the coalition partners want to remain independent in their internal decisions, and the coalition is seen as a short term commitment functional to reach the own goal(s).¹⁶ In such cases the number of groups may be enlarged, and the notion of planning cone adjusted. In such an extended model a state comprises realities and chosen plans for more than two groups. Still, a binary feature remains important insofar as each group will belong to one of two 'coalitions', and conflicting plans will be chosen by groups from different coalitions. H1 - H4 may easily be adjusted to this more general case.

¹⁶This does not imply that such coalitions are less effective than the tight ones.

3. *The decision process.* In my theory any transition from one state to the following one involves the elimination and/or introduction of propositions believed to hold, and of chosen plans. In principle, each single omission or introduction of a proposition or a plan could be made the subject of an explicit decision according to some decision model. If such a model were available it could easily be fitted into my model of binary crises.

The main problem with most existing, empirical approaches to decisions is that they presuppose utilities or, in weaker forms, preferences which have to be given before the decision is taken. Though reference to preferences or weaker forms of orderings of goals seems unavoidable the practical difficulty is that these are largely unknown and unaccessible. It seems difficult to collect preferences of the members of a decision group, first, because initially there is no clear survey of the alternatives that may come up in the development, and second, even if there were such a list of alternatives, the leaders would resist to reveal their preferences for this would make them ‘calculable’ for the enemy. In real decisions, rationality will remain ‘bounded’, and the best that can be expected at present are practically oriented models of decisions in a group taking into account the psychological characteristics of the actors.

There is an alternative line of supporting decisions, though. Instead of trying to rationalize them in terms of given preferences one might try to improve the decision makers’ perceptions of the (potential) crisis they are engaging in. Misperception is stressed in the literature throughout. Now in order to get the right perception of what is going on in a crisis it is certainly helpful to have a simple model like the one presented here in one’s head. Such a model serves as a guide in the formation of adequate perceptions, and these together with some elements of rational decision will greatly improve the decision process.

8. Application

Though my presentation focuses on the theoretical model the main goal in developing it was to provide a comprehensive basis for (computer)

application. Though such application has not been done yet, I want to consider the salient points involved in a computer application.

1. For application, the propositions must be specified in a fixed format, involving a system of verbal phrases and time,¹⁷ and a database containing information about meaning implication \preceq and negation \neg , as well as some minimal derivation system must be added.
2. The structure of plans must be specified such that plan generation can be automated on the basis of given propositions, goals, and causal or probabilistic information of their relations.¹⁸
3. Some rules have to be specified for the interplay of believed propositions and the choice of plans over time. These rules incorporate what I called patterns of a development above, and they refer to links and commitments in the database as well as to relations of feasibility, compatibility and incompatibility which can be generated from the proposition component.
4. A decision component must be present steering the introduction and elimination of propositions and plans into and from the planning cones.
5. While items 1) and 2) can be implemented in a complete way, the rules in 3) can be complete - in the sense of covering all interesting forms of interplay - only at the cost of specializing on some particular kind of pattern(s), and 4) will remain a desideratum for quite a while. Even with items 1), 2) and a partial set of rules in 3), however, an implementation may become a useful tool, for on the basis of the general model this allows to calculate potentially dangerous developments: states which can be the origin of a full blown crisis.¹⁹

The full blown treatment of an example is beyond the scope of a paper, requiring too much space. In order to give a feeling of what is involved in

¹⁷Examples of such systems are found in (Ballmer & Brennenstuhl, 1981) and (Brecher, 1977).

¹⁸There is a rich literature on automated plan generation. For the present model, a special definition of plans was tailored by Sander (1993).

¹⁹A specification for such a program - leaving 1) at the abstract level - was developed by (Sander, 1993).

the application of the model, let me consider the Cuban Missile Crisis of 1962 in a rather sketchy way.²⁰ As this crisis was settled without fighting the weaker assumptions P1 - P4 of Sec. 5 are relevant here. At the coarsest level, eight periods of time may be distinguished each period being identified by salient events occurring in it. The first period t_1 , started with the first meeting of the Executive Committee of the National Security Council (ExCom) on October 16, after US reconnaissance planes had taken photographs of construction work at the missile sites. The ExCom discussed several alternative plans about how to react and then decided on October 20 (which is period t_2) to postpone an air attack against the missile sites and instead to impose a naval blockade around Cuba and to put pressure on the USSR as a first step. After that date, the US tried to pave the way for gaining the Organization of American States' (OAS) assent to the intended blockade. On the evening of October 22 (Washington time) which marks the end of period t_3 , John F. Kennedy (JFK) delivered a television address to the world announcing the blockade with threatening gestures towards Moscow, and asking for an urgent meeting of OAS and the UN Security Council. During the president's speech the US military were put on the alert Defense Condition (DEFCON) 3, the Strategic Air Command was set on DEFCON 2, one level below actual combat order. The TV-speech came as a surprise for the Soviets. While the USSR could observe the measures taken by the US forces, they still refrained from major military action.²¹ As expected by the ExCom, the OAS delivered an unanimous vote on October 23 (period t_4) in which they condemned the installation of missiles in Cuba, demanded their removal and advocated the blockade. A few hours later JFK signed a proclamation, prohibiting the shipment of offensive arms to Cuba; and on October 24, 10 a.m. (which is the beginning of t_5), the blockade took effect. By way of letters and other channels Moscow denied the presence of the missiles and claimed the blockade to be a violation of the UN-Charter and of international maritime law. Soviet ships would disregard the blockade and counter-measures would be taken. In spite of these announcements there was evidence that all of the 16 ships heading

²⁰The following account draws from a detailed analysis by A. Gayhoff under DFG project Ba 678/4-1, and does not attempt to document the events from the sources, like (Allison, 1971), (Blight and Welch, 1990), (Garthoff, 1989), and (Pope, 1982), as done by Gayhoff.

²¹The Cuban army, however, was mobilized.

for Cuba and carrying military freight stopped or returned. Soviet submarines, however, appeared and temporarily took position between the freighters in front of the fence line. Other Soviet submarines were pursued and pressed by US cruisers. At the same time construction works at the missile sites proceeded with increased speed, so that the ExCom considered intensifying the blockade or starting an air raid. On account of reports of his secret services on imminent invasion Khrushchev wrote a letter on October 26 (period t_6) suggesting to retreat the missile sites if the US guarantees not to invade Cuba. Further secret consultations between Dobrynin and Robert F. Kennedy, and between Scali and Fomin led to Khrushchev's letter, dated October 27 (beginning period t_7) suggesting USSR withdrawal of the missiles from Cuba if the US were ready to retreat the Jupiter-missiles from Turkey. JFK in his answer disregarded the suggestion of a missile trade completely, but accepted it on an informal level by encouraging his brother to let Dobrynin understand that the US intends to withdraw the Jupiters. On October 28 (period t_8) Khrushchev agreed on the conditions of his letter of October 26 with an additional non-public promise by JFK, and this brought the crisis to its end.

From this brief summary of the events some of the plans which were discussed or chosen during some of the periods may be reconstructed. For the US the most salient plans were:

- p_1 : to write a letter to Khrushchev and press for secret withdrawal (chosen on October 18 - 20 (= t_1) and then dropped)
- p_2 : to set up a sea blockade around Cuba and put pressure on the USSR (chosen during October 20 - 28 (= t_3 up to t_8))
- p_3 : to launch an air attack in order to destroy the launching pads²²
- p_4 : to invade Cuba²³

²²After a meeting of ExCom-members with General Sweeney on October 20 JFK decided that this plan p_5 should be made contingent on p_2 's not being successful (Garthoff, 1989, pp. 52, 73 - 74). A plan for preparation of an air-raide was chosen on October 16-28.

²³ p_4 was chosen in the sense that preparations were made for invading Cuba. But an initial condition of p_4 was that p_2 should have failed. The meeting on October 20 (mentioned in the previous footnote) made clear that an air-attack against the missile sites would entail a full invasion during the next days.

p_5 : to win assent of the OAS (chosen during October 20 - 23 (= t_3 and t_4))

p_6 : to achieve a diplomatic compromise including a missile trade (chosen from October 26 - 28 (= t_6 up to t_8) and the days after hot crisis

p_7 : to prepare for comprehensive atomic war (chosen from October 20 - 28 (= t_3 up to t_8)).

On the side of the USSR the following plans are visible.

p'_1 : to install medium range missiles in Cuba²⁴

p'_2 : to deter the US from attacking Cuba (chosen from October 23 - 28. (= t_4 up to t_8))

p'_3 : to make the US remove the blockade (chosen from October 23 - 25 (= t_4 and t_5))

p'_4 : to get the US accepting the missiles by means of diplomatic activities (chosen from October 23 - 25 (= t_4 and t_5))

p'_5 : to negotiate for a removal of US-missiles in Turkey in exchange to stopping the build-up in Cuba, (chosen from October 26 - 28 (= t_6 up to t_8) and the days after the hot crisis)

p'_6 : to prepare for comprehensive atomic war (chosen from October 23 - 28 (= t_4 up to t_8)).

It is not known whether there was a Russian plan to involve West-Berlin in subsequent negotiations or even to seize the city.²⁵ However, the USSR were aware of the American commitment to defend West-Berlin in case of military attack.

Among these plans it is easy to find plans which are in conflict. This is at least the case for the pairs $p_4 - p'_1$, $p_2 - p'_1$. In view of p_1 we have to decide which pair was the first being in conflict. This depends on which pair was first perceived as chosen by both parties. As far as known, the USSR first perceived - in period t_3 - that the US had chosen p_2 , and

²⁴ p'_1 , was chosen from October 23 - 28 (= t_4 up to t_8) despite of the detection of the build-up by the USA which became known to the Kremlin by the TV-speech of JFK on October 22. The original plan for secret installation had been chosen since May 1962.

²⁵See (Allison, 1971, pp. 52. 241 -243), (Garthoff, 1989, pp 21 -22), (Blight & Welch, 1990, pp 159 - 160, 177, 327).

only later became aware of the plan of full invasion. With respect to p_2 , conflict did arise as soon as that plan was realized by the USSR, namely at the end of t_3 on October 22 after JFK's TV-speech. So the end of t_3 marks the beginning of the crisis. At that moment we first encounter plans which are in conflict in the sense of the definition of Sec. 3. Thus, p_1 is satisfied with t_3 and the conflicting plans p_2 and p'_1 ,²⁶ and the respective goals of these plans according to p_2 are the crisis goals. The goal of plan p_2 may be described as preventing the installation of missiles in Cuba which is, in fact, the negation of $goal(p'_1)$.

p_3, p_4, p_7 are crash plans for the US and p'_6 for the USSR because these plans involve large scale military action and probable damage. All the plans mentioned were linked to the crisis goals so that P3 is satisfied.

The crisis ended when the USSR gave up its crisis plan of installing the missiles in period p_8 . As period t_3 is the first and t_8 the last one, P4 requires to investigate the transitions from t_i to t_{i+1} for $i = 3, \dots, 7$.

Among other things, this requires a comparison of the sets of chosen plans in any two succeeding states and the conditions occurring in those plans. It also has to be investigated which propositions were thought to be true by both parties in the different periods, a task which is difficult to achieve in detail. I can only indicate here some propositions believed by the parties. In the context of plan p_2 (naval blockade) the US believed - among others - in the following propositions:

- b_1 : OAS condemn the installation in Cuba, demand their removal and support the blockade (believed on October 23)
- b_2 : OAS justify the blockade by their vote (believed on October 23)
- b_3 : the blockade is in effect (believed in October 24, 10 a.m.)
- b_4 : reconnaissance flights are permanently performed
- b_5 : there are no major combats on the open sea (believed in all periods)
- b_6 : freighters approaching the line of blockade are stopped (believed on October 23 - 24)
- b_7 : construction work at the missile sites will slow down over time (a

²⁶Of course, the USSR's plan p'_1 , was also chosen at earlier times but then it was not in conflict with a US plan because the US did not realize it, see condition 3) in Sec. 3.

belief expressed in the ExCom on October 26, and in JFK's TV-speech)

b_8 : construction work at the missile sites is deterred by threatening the USSR with an attack against Cuba (believed before October 26)

b_9 : the USSR leaders could be influenced by threatening with a preemptive strike.

In the context of plan p'_3 (making the US remove the blockade) the USSR group believed in the following propositions - among others.

c_1 : USSR submarines near the own freighters will threaten the US

c_2 : letters firmly announcing continuation of the own activities will probably make the US remove the blockade

c_3 : announcing a firm stand in a message to Knox on October 24 will make US removal more probable

c_4 : speeches to the UN Security Council will have a positive effect on the US to withdraw.

Another plan, p'_4 , of the USSR (to get the USA accepting the missiles) reveals beliefs that the letters written by Khrushchev dated October 23 and October 24 may influence the decision of JFK, that JFK's opinion may be influenced by the message to Knox on October 24, and by speeches to the UN Security Council.

Turning to the evaluation of P4 it can be held that the number of realized conditions in the crash plans for both groups increased in each transition.²⁷ The military preparations went on throughout the period. In view of the definition of ' s_{t+1} ' is more narrow than it has to be checked whether this increase is not counteracted or 'devaluated' by a similar increase in the number of realized conditions of non crash plans. On the USSR's side we may say that execution of the non crash plans became more difficult. The plan of installing missiles in Cuba is finally abandoned, one reason for this being the negation - by the US blockade - of the plan's condition of free access to Cuba. Also, commitments of the US prevented the USSR from retaliating in Berlin or Turkey (though corresponding plans cannot be reconstructed from the known data). Al-

²⁷'Increase' in the sense of 'greater or equal'.

together, some conditions of non crash plans became inoperative while no conditions got better realized during the five transitions. So, for the USSR, the increase of ‘true’ conditions in the crash plans was not devaluated by a countermovement in the non crash plans, and the USSR’s ‘part’ of P4 is satisfied.

The US’s ‘part’ of P4 is more problematic because here some of its non crash plans clearly did improve. The conditions of the non crash plan p_2 (‘blockade’) got fully realized from t_2 to t_8 . Also, during the transition from t_3 to t_4 the conditions of p_3 (‘winning assent of the OAS’) became realized. So the ‘increase’ of ‘crash conditions’ is accompanied by a simultaneous increase of ‘non crash conditions’, and the question is which kind of increase is stronger and therefore decisive for the evaluation. It seems very difficult to really count the numbers of relevant conditions of both kinds which got realized in each transition. Switching to the notion of a weight function mentioned in note 14, however, a rough judgement may be achieved. Using this term, the question is which set of conditions is more ‘weighty’ or important: the set of those getting realized in the crash plans or the set of those getting realized in the non crash plans. Now all the non crash plans considered are instrumental for achieving the crisis goal by making the USSR step back. In terms of (Lebow, 1981) the crisis is a brinkmanship crisis. From this point of view the success of non crash plans cannot be taken as an indication of detente. On the contrary: as long as the USSR had not given up its crisis goal all the improvements of non crash plans at the side of the US must be seen as escalating the crisis. Therefore the weight of conditions in such plans cannot be taken to exceed the weight of conditions in crash plans as far as escalation is concerned. This does of course not demonstrate that P4 is satisfied but indicates that P4 will turn out as valid under closer investigation also for the US.²⁸

9. Comparison with Other Approaches

The model presented here in a certain sense ‘contains’ many of the characteristics, criteria, or conditions of crises put forward and discussed in

²⁸It may be mentioned that in cases where the crisis ends with a crash - like the outbreak of the first world war, Korea, or Falkland-Malvinas - the hypotheses are satisfied much more convincingly.

the literature. This does not mean that all other concepts and characteristics discussed can be explicitly defined in terms of the model or are logically implied by H1 - H4. However, most of these other concepts and hypotheses can be defined and derived in natural extensions, specializations or refinements of our models, and in this sense are 'contained in' it. As stressed before, the present model is intended as a basic model, a model common to all binary crises. By introducing particular patterns of development it may be further specialized in order to capture the particular features of particular crises.

1. In a crisis the probability for the use of force is high.²⁹ This characteristic is directly present in the model by the nature of the groups' 'limit states', to which the planning cone converges. Each limit state contains only crash plans the execution of which involves force. As the planning cone converges to these plans, the probability of its execution increases. and so does the probability of the use of force.
2. In a crisis basic values of the group are highly threatened.³⁰ I did not explicitly introduce the notion of values but it is clear that values are closely linked with goals. In fact, some goals are direct expressions of values. On the other hand, there also are plans the goals of which do not directly correspond to a value. So there may be reason for introducing values as an extra primitive. Without extending the vocabulary the model may be enriched by a set of values each value being expressed by one or several propositions. Then threat can be modelled by assuming that the crisis goals are among, or are closely linked to, those values (where linkage may be expressed by meaning implication \preceq).
3. In crises decisions have to be taken under increasing pressure of time.³¹ Adding a metrical structure to the set of time points expressions like 'the time in which a decision has to be taken' become available. As propositions may refer to (one or several) points of

²⁹ See (Brecher, 1979, pp. 5 - 6) and (Lebow, 1981, p. 11).

³⁰ See (Hermann, 1972, pp. 3 - 17), (Brecher, 1979, pp. 5 - 6), and (Lebow, 1981, p. 10).

³¹ See Hermann (1972, pp. 3 - 17), Brecher (1979, pp. 5 - 6), and Lebow (1981, p. 12).

time it is then easy to spell out the nature of time pressure under which plans have to be chosen.

4. Crises, show a high volume and intensity of events.³² The category of event or action was not needed in order to formulate my hypotheses. It is clear that action is highly relevant to a more fine-grained description which specifies patterns of development and interaction, but it is also clear that action can be added easily. Actions are described by propositions, so we just have to introduce expressions of the form of '*group G performs action a in period t*': $perform(G, a, t)$, in order to include the dimension of action. On the other hand, it is not clear whether this will be sufficient to express the characteristics of high intensity of actions. Intuitively, intensity of actions arises from activity of all the diplomatic and/or military apparatus plus the media³³ and therefore should not be ascribed to a group which is taken as an unanalyzed object. It seems that a further refinement of the model would be necessary in order to express such a condition: the groups would have to be further analyzed as structured sets of persons. As noted, this yields a natural extension of the present theory.
5. In crises there is a high amount of stress.³⁴ This points to the dimension of individual psychology, which is not included here. I do not deny that psychological features, including principles of decision making, are, or can be, important to a crisis. They are, however, the most difficult features in this context. Much of the theory on decision making is normative rather than descriptive, and therefore cannot be brought to bear. On the other hand, the psychological situation in a group of crisis managers is most difficult to investigate for usually such groups are not directly accessible to the scientist, indirect information may be strongly biased, and laboratory experiments are too far removed from reality.
6. Crises may have a component of surprise.³⁵ This can be modelled in terms of plans and goals. If, at the time of perception of the

³²See (McClelland, 1968, p. 161).

³³A good illustration is (McClelland, 1968).

³⁴See (Holsti, 1972).

³⁵(Hermann, 1972, p. 13).

opposing group's crisis goal there are no plans at all of how to prevent that group from achieving the goal, we have a situation of surprise.

7. Some authors discuss disruptive change of the system or challenge to an international system.³⁶ Challenge of a system, I think, is partially represented by talking of threat of basic values which was discussed under item 2. above. It is clear, however, that the full international system cannot be treated in any natural extension of the present theory.
8. Change of the system³⁷ - as far as it does not mean challenge of an international or external system - refers to components internal to the system. It is not very clear what is meant here by 'the system'; I take it that this expression refers to the institutional setting of each group: its status and role in its surrounding social system or state. The inclusion of this criterion affords an extension towards the theory of institutions. As already mentioned, this can be done by incorporating the groups into a model of institutions as described, for example, in Balzer (1993).

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