Towards a Resolution of Terrorism using Game Theory

Coalitions, negotiations and audience costs

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ABSTRACT

Both terrorism and game theory are contested concepts within the social sciences, but in this paper, I will show that a rational approach (game theory) towards the emotion-laden idea and practice of terrorism *does* aid understanding of the "terrorist theatre".

First, an outline will be provided on the type of actors (game players) that are, or may be, involved to a more or lesser extend in (supporting) terrorism. Then several game models will be assessed on their applicability. This includes averting the joint bargaining paradox when asymmetric actors cooperate to achieve a joint goal, governments who may fare better from their point of view when dividing up refugees into geographically separate areas to decrease the possibility of cooperation between aggrieved groups and recognizing two-speed negotiations, which can have a (detrimental) effect on (deadline) negotiations. Further, an adaptation of the audience cost model explained the "war of nerves" of the terrorist theatre involving the generation of fear amongst its targets and the updating of information on moderate actors by action of extremists. Several mutations of the Prisoner's Dilemma were discussed as options to prevent mutual harm.

> *A little bit of simple rational analysis – say as a consultant to the terrorists and food poisoners – could quickly suggest how much worse matters could be. Fortunately terrorist groups do not appear to employ management science and operations research departments.*
>
> Martin Shubik (1987:1519)

> *Remarkably, we have just improved our position by taking steps to undermine our own military strength. Those who think that unilateral disarmament is invariably nonsensical do not know their elementary game theory very well.*
>
> Yanis Varoufakis (1991:61)

It may be a provocative title at first glance, where the last word on (conceptualization of) terrorism has not been said and the applicability of game theory to the social sciences open to much debate, but in this paper I will show that a rational approach (game theory) *does* aid understanding of the emotion-laden "terrorist theatre"

In order to untangle the knot, I will first discuss the actors involved in terrorism to set the stage for subsequent modelling of situations involving what is generally consider to be terrorism (the use of physical and psychological violence as a means to achieve a political goal). Then I will look into the concept of (exploitation of) audience costs, i.e. loss of reputation of a "player" in the game, possibilities of averting the mutual harm linked to the Prisoner's Dilemma and the wider aspect of

cooperation and competition during negotiations (assuming that at some stage a certain level of dialogue between the actors is a prerequisite for building positive peace). These paragraphs rely heavily on adaptations of general game theoretical and political science models, as the resources on the combination of terrorism and game theory are sparse. Last, I discuss briefly the sense of using game theory as a tool for modelling and understanding terrorism and finalise with some conclusions and suggestions for further research.

1. ACTORS INVOLVED IN TERRORISM

What is the nature of a terrorist organisation? How do they emerge? Do they receive "outside" support? What positions are possible for other states involved in the conflict? These questions are explored in this paragraph. First, I consider general sociological characteristics, then the aggrieved groups and finally state actors involved in terrorist conflicts.

1.1 Sociology of movements and factions

Wieviorka (1988) has carried out research into terrorism from the perspective of sociology, particularly into what makes groups change from social movement, like labour organisations, to social antimovement that subsequently may give way to a terrorist organisation, which is 'the most extreme and distorted form an

antimovement can take' (p5). The reasoning, alluded to by Crenshaw (1981) in a slightly more watered down version, is as follows:

1. The dimensions of a social movement are based on principles of identity, opposition and totality, articulated on a theoretical level.
2. The social antimovement, which may surface / "grow out": of / separate from the labour movement when labour conditions deteriorate, starts with inverting these three characteristics and synthesises them together into a single whole. The main characteristic of a social antimovement is that 'it transfers its actors from a prior relationship of social domination into a situation of estrangement or disengagement' (Wieviorka, 1988:19).
3. The switch to terrorist organisation is initiated by an 'exogenous factor, set in motion by the intervention of specific actors who are foreign to the labor movement' (Wieviorka, 1988:17) and fuelled by an unresponsive institutional system that has closed in on itself and incapable or unwilling to deal with social demands. Further, it is those terrorists who have lost their sense of reality by being too disengaged and cut off from the rest of society, which 'lies at the very heart of terrorist activity: the processes of *inversion* through which a collective action loses touch with its original guiding principles' (p57).

Especially interesting is Wieviorka's distinction that the change from social movement to antimovement occurs from within the organisation, but that to become a terrorist organisation requires external influence. Secondly, drawing the fine line between "social violence" and "terrorist violence" is difficult, if not 'impossible' (Heumann and Vogel, 2001). Is incidental violence social violence, but re-emerging violence terrorist violence? Or could the first maybe failed terrorists, and the second

"too successful" social violence? Third, are terrorist really cut off from society? Not necessarily: a) the *Freizeit-Terrorist* must be familiar with "normal life" to create the best cover and b) there are all-encompassing organisations like Hizbollah, who, besides engaging in protracted conflict in south Lebanon, provide education, various religious and community services and agricultural support. Fourth, Wieviorka claims that violence erupts from universities, students working on the assembly line and unemployed ex-students, who 'cut and paste ideologies' (Wieviorka, 1988:41) – resulting in an ongoing process of division and recombination within the terrorist arena. Sandole (2002) then argues that once the conflict has erupted, it may become self-stimulating and self-perpetuating once the violence passed a certain threshold, as if there is no way back like the one-way ticket of Wieviorka's three stages. There are ample examples confirming and contradicting this hypothesis. Chomsky (2001) voices a more nuanced version, considering small interchanging affinity groups who do business[1], a principle developed by the Christian right in the USA.

Besides social movements, there are political movements, though this distinction does not exclude social movements from being involved in politics. But where there may be social and communal groups sprouting to address a single issue, political parties cover more topics and are seen as 'the product of important changes in the structure of the state and society' (Weinberg, 1991:426). Then Weinberg advocates that in the relationship between political failure and recourse of terrorism 'some dramatic *external* event(s) that provides a sufficient shock to cause a group of individuals to embark on the terrorist path' (emphasis added) (p427) in contrast with political parties, who are 'more likely to be the products of longer periods of gestation'(p427). Following this line of thought, one actually may consider terrorists

[1] Original wording 'Man hat kleine Gruppe die Sachen tun', where "Sachen" not only translates into doing business, but its meaning also includes more shady activities, alike the Irish "brown envelope culture".

groups a result of even longer gestation: first they try the political route and upon repeated failure some members separate from the political faction and carry out political terrorism. Another possibility that may occur in parallel is the co-existence of both, in some way interdependent or in competition with each other for support by the masses. A curious result of Weinberg's analysis of links between political parties and terrorist movements is, that terrorist groups with connections to a political party seem to survive longer; he has no idea why. However, one can think of changing circumstances in society, where, depending on the fluctuations, sometimes violence might appear more effective and in other times the political approach. I will elaborate on this aspect in subsequent paragraphs.

Topics transcending the two discussed are the logic of collective action and the influence of peer pressure. It is outside the scope of this research, but these aspects of internal group dynamics with regards to terrorist organisations (covering localised 'cells'), the psychology of terrorists, would be highly interesting to investigate.

1.2 Aggrieved groups

In the previous paragraphs I used words like "terrorist organisation", "terrorist group" and "terrorist cell" for convenience, because this is how they are normally referred to, even though, or precisely because, this implies subjectivism and bias, as one may call these organized groups terrorists, others would say freedom fighters, or resistance for a just cause. To avoid this negative branding, I will use the more

neutral term “aggrieved group” to refer to these groups, and it is up to the reader to judge and categorise which label is applicable to whom.

Aggrieved groups have specific political objectives and believe that violence is an inevitable means to achieve their political ends. Objectives vary widely, from defending/aspiring land, religions, nationalities or ideologies. Roughly, this can be divided as having a basis in ideological or refugee-based disorders (Kahn, 1987):

- Ideological disorders: comprising right-wing (e.g. racist) and left-wing (e.g. Marxist) ideologies that may be focussed within the state and/or on the international stage;
- Refugee-based disorders, incorporating Diaspora and people in exile, including liberation struggles: the aim is to get “their own” country or region back, most often being fought from a refugee area outside the borders of the country they are targeting, i.e. they are per definition supranational oriented and part of the ‘triangle refugee-group, supportive state(s) and suppressive state(s)’ (Kahn, 1987).

It is important to make this distinction here, because the responses on the two types of aggrieved groups are distinct:

> Although the international community often recognizes the plight of aggrieved groups under colonial and racist regimes and other forms of alien domination, and upholds the legitimacy of their struggle, no such recognition is generally accorded to groups promoting a specific economic ideology. (Kahn, 1987)

According to the UN[2], struggle by peoples under above cited regimes is legitimate, as these peoples have the right to self-determination and independence. One note of caution here is, that the Resolution is, as always, a compromise with ambiguous wording, and a signatory state does not necessarily follow the guidelines of a UN resolution. Furthermore, if one defines terrorism by its method of operation and measures legitimacy in accordance with UN Resolutions like the Universal Declaration of Human Rights, an ideological disorder may have legitimacy as well, but may be harder to prove than "self determination and independence".

In line with Weinberg's terrorist - political party delicate relation, the aggrieved group, from either type, consists of "moderates" and "hardliners" – assuming there is a division between reluctant terrorists and terrorists who whole-heartedly stand behind the violent acts. This suggests that the aggrieved group is *not* homogenous nor that terrorists have 'a similar background' as Crenshaw (1981:389) advocated. However, this aspect may have changed over the past 20-30 years. The move from rural to urban-based struggle via cells necessarily has had an effect on the composition of an aggrieved group, and the increased level of technology and internationalisation doesn't require a farmer fighting for a piece of land, but an moderately to highly educated (middle-class (Wilkinson (1977) and Kristof (2002))) person. With the increase in technology and mobility comes a higher price tag to finance the activities. One possibility in procurement of finances is to ask or accept an offer from supporters, but this creates dependency; another, developed in the 1980s and 1990s, is setting up "Terrorist Inc."[3].

The aspect of differences among and within aggrieved groups will be further discussed in chapter 4 in the context of game theory.

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[2] G.A. Resolution 3103, 28 U.N. GAOR Supp. (No 30) at 512, U.N. Doc A/9102 (1973), as cited in Khan (1987).

[3] Examples are provided by Bakhash (1987) and, more recently, by Heumann and Vogel (2001).

1.3 Other involved actors

The media and politicians liken to treat aggrieved groups as insular entities, but in principle, this is not possible: even if it were a "purely" domestic conflict, an aggrieved group is campaigning against a / the state. Additionally, because of the increased interdependence and internationalisation of societies and higher levels of funding required, it is possible to identify at least five other actors involved in a conflict. These are supportive states and groups, suppressive states and groups and international organisations. A further sub-division can be made into both principle and accessory supportive/suppressive states.

Supportive states: Accessory supportive states provide moral support to the aggrieved group, which might sound little distinct from being neutral, but effective moral support from states that promote the political objectives, officially positioned as being outside of the problem, does provide extended legitimacy of the actions of the aggrieved group (Kahn, 1987). A principal supportive state not only provides moral support, but also resources (finance, military, active training etc.), though sometimes support may not be voiced loud and clear for international political reasons.

Supportive groups: For example the Diaspora, other aggrieved groups involved in a similar conflict in another geographical region to exchange strategies and moral

support and aggrieved groups involved in another type of conflict, but who can provide technical assistance in deploying new methods of violent acts. Bearing the financing of terrorism in mind, in this context multinational corporations owned by people who are also member of an aggrieved group as well as the wider financial sector, "regular" companies may do business with Terrorist Inc., which can be interpreted as either directly or indirectly providing funds to an aggrieved group, thereby perpetuating the conflict.

Suppressive states and groups: The distinction between principal or accessory suppressive state largely depends on perception of the aggrieved group of the particular state and the consistency in opposing the aggrieved group (Kahn, 1987), as well as the policies applied by the suppressive state.

There may be principal or accessory suppressive groups who either compete for the same base or have a distinct ideology. The line between suppressive states and groups may be unclear in certain circumstances, as a suppressive group might be, directly or indirectly, supported by the same or another suppressive state.

International organisations: Undoubtedly, these organisations are players in the terrorist theatre, and due to previously discussed problems of definitions and interpretations, can be any stance varying from active support to active suppression, including gradations of accessory, moral, supportive or suppressive attitude – or "passively" ignoring a protracted conflict, although inaction is to some extend taking sides as well.

Real life is more complicated than these clear distinctions, as it is common practice for a state to be categorized as more than one type of state not only over time, but especially *at the same time* with regards to different conflicts. This conflicting characterization is part of the wider problem, as 'the dual approach of measuring with two standards towards violence and terrorism impairs the orderly functioning of the international system' (Kahn, 1987): labels become weapons to influence, and even to manipulate, domestic and international public opinion. Thus, the interplay does not quite resemble a triangle as much as a polygon, where all supportive and suppressive actors could be involved, or dragged into a conflict that, because of external influences, may lead to at least continuation of a protracted low intensity conflict, fuel a proxy war or become the source of a full fledged world war, or provide a stimulus in resolving the conflict.

2. AUDIENCE COSTS

The term audience cost, first introduced by Fearon (1994), describes a situation on the international political stage when a leader of one country backs down in an international crisis with another country. Costs increase the longer the duration of the crisis, but it depends on behaviour and decisions if the leader actually "pays" the costs. Payment should not be interpreted in monetary terms, but a measurable extension of loss of reputation in the form of not being re-elected by the public as the most serious incurred cost (that is, assuming the leader wants to be re-elected). This definition begs the question how audience costs can be measured in non-

democracies, and for non-state terrorists, to which I will return after addressing general audience cost related factors.

The game is modelled as a War of Attrition, having a continuum of Nash equilibria, though with three options in the set of strategies instead of two: attack the other country, back down or continue the crisis, where the cost of continuing is mapped onto the discounted value for each round, hence imagine this as the increase of the build-up of the audience cost. Paying the cost counts for both challenging states backing down and for a challenged state that first resists and subsequently backs down. This model predicts that democracies, being able to generate more audience costs than a non-democracy and therefore more capable of signalling their intention more accurately, are less likely to back down in a crisis situation.

However, it does not address *how* audience costs may be generated. Smith (1998) argues that, when in equilibrium, only the least competent leaders will back down during a crisis and will pay audience costs and that '[t]he possibility of war is necessary to keep leaders honest' (Smith, 1998:633) (when signals do not threaten they are worthless). Brito and Intriligator (1985) attribute this positive probability of war to a separating equilibrium induced by one country and has its basis in asymmetric information in order to prevent bluffing by the informed state. However, Smith's model[4] ignores the possibility that a leader may back down because of new information that would make a war unjustified, hence not legal and/or foolish to continue the crisis or attack; conversely, 'non-intervention signals lower competence' (Smith, 1998:633) of the leader. Inherent in the War of Attrition is the tendency towards 'belligerent equilibria' (Meyerson, 1991:330) and exacerbated by

[4] The values and importance he attaches to the different strategic options. In itself, the extensive form game of the International Crisis Game (included in *Appendix A*) can be a useful modelling tool.

the two-tier bargaining[5], it results in a bias towards hawkish strategies. A striking example of the limitations on audience cost build-up and the strong bellicose leader bias is the Iraqi crisis in 2002/2003: "dove" US Secretary of State Colin Powell made a U-turn towards supporting an invasion of Iraq; though strictly according to the audience cost definition, he would not have suffered credibility, but he did.

An extension of the domestic politics factor of audience cost generation is the influence of an opposition party on the stance of the leader (/government), in addition to the voting public. An opposition party can lend additional credibility to threats signalled by the government when "even the opposition supports the government's stance", but also makes the government more selective in signalling, in the form of the opposition as 'watchdog' because the opposition has no incentive to support a bluffing government. Guisinger and Smith (2002:197) consider this wider combination as "domestic accountability". The credibility an opposition party lends to the government makes the leader more selective, but stronger, in the international crises. Because non-democracies do not have one or more opposition parties, nor voting citizens, they cannot build up audience costs like their democratic counterparts, in turn affecting the credibility of a threat, or any signalling for that matter[6].

Prins (2003) adds that institutional stability in general allows for more precise signalling (conversely, instability hampers successful signalling of true intentions)

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[5] Which is the dynamics between international and domestic politics, see Putnam (1988) for an explanation of the concept.

[6] This, however, does not preclude that any type of signalling or even cheap talk, has no effect when it comes from a dictator or autocrat (see e.g. Croson *et al* (2003)). It is alluring to provide Saddam Hussein in the build-up to the US/UK-led invasion of Iraq as an example: despite his repeated claims of not possessing weapons of mass destruction, primarily the US and UK governments preferred not to believe him, nor his 'signalling' to invite the UN weapons inspectors in, whereas other countries and coalitions gave him the benefit of the doubt. At the time of writing, it is too early to tell if this could serve as an example of a lower capability to build up audience costs and lack of credibility of non-democratic states, or if the US and UK governments will have to pay large audience costs (even though it would not support Schultz' (2001) simulation.

and regimes 'with non-institutionalized political participation engage in more escalatory behavior' (p82)[7].

Schultz (2001) tried to put the concept of audience costs to the test, but noted problems on partial observability and strategic selection of cases, claiming one can only detect audience costs when it actually incurred. Based on a Monte Carlo simulation, 'only states with relatively low audience costs ever incur them' (Schultz, 2001:48), which makes intuitive sense because when the audience costs are too high, the cost of backing down for a belligerent leader is too much. For example Roddy (2003) observed George W. Bush's build up to the Iraqi invasion that 'the steering wheel long ago exited the driver's side window', implicitly suggesting that the "strong and powerful leader" who does not back down according to the model, has actually lost control over his own power.

With outlined variations and extensions of the audience costs model, it indicates that strong leaders never back down (weak leaders do) and when the leader has a stable democratic apparatus behind him, the threats he's signalling are more credible and better reveal his true intentions than his non-democratic counterpart. Despite the fact that there is still plenty of further research possible on the audience costs in international politics, I endeavour to apply the concept of audience costs to the terrorist theatre, and assess factors that need to be addressed in order to make it a possible useful tool.

[7] This author disagrees with his model; on the artificially introduced dualism of democracy versus non-democracy, where curtailing executive power is more important than multiparty systems, but subsequently Prins contradicts himself in that it is this aspect of competitive participation as an important factor. Moreover, he restricts "formal alliance ties" only to defence pacts, as if bi- and multilateral trade agreements would not have an effect on crisis bargaining, escalation and resulting from that the audience costs.

First, would it be possible for terrorist groups to generate audience costs according to aforementioned definition within their own supporters group, and in the "electorate"? (The latter envisaged as citizens of the affected area, including supporters and non-supporters.) Aside from a few exceptions, aggrieved group leaders do not get voted into government nor can be voted out of office or Politburo every four or five years, which would make the situation analogous to a non-democracy, and less capable of generating audience costs in the first place. Restricting the possibility of generating audience cost to the inner working of an organised aggrieved group, for example the leader promising a new and better world or more equal pay to his followers which does not materialize, is an interesting avenue for investigation. Crenshaw (1991) asserts that one of the reasons terrorism declines is through organisational disintegration, which thus could be an effect of a bluffing leader, though data is hard to find and inconclusive.

Second, even though I cannot assess the internal audience cost build-up, and the organisation of an aggrieved group is not as democratic as a democratic state, common sense points towards a likelihood of audience cost generation with the wider public, as it is exactly the threats made by these organisations that contribute for a large part to their importance. However, from the game theoretical framework outlined by Fearon, Smith and Schultz among others, this cannot be possible. It is easy to assume that either there is something lacking in the model, or the people rationally should not believe the threats because they originate from unreliable sources (according to the definition). There is another option: an aggrieved group *exploiting* the audience cost model, as opposed to being "trapped" in it like a state leader. The reasoning is as follows: the aggrieved group commits a terrorist act, succeeded by several threats that are not carried out, leading the people to believe the

aggrieved group is not trustworthy in its threats. The people are lulled into a sense of security, relax imposed restrictions and foster the idea that the terrorist act was an isolated event, and then the aggrieved group actually implements a threatened action. Thereby the aggrieved group is taking advantage of the less credible signalling, messing up the neat Bayesian updating of the public's belief system about the terrorist organisation in that the probabilities cannot be realistically updated. Worded differently: one can update the probability of the type of player after each threat, but this does not provide more information on the aggrieved group and/or "terrorist" leader, *defeating the main point that Bayesian updating is supposed to deliver in a game*; alike a War of Nerves instead of a War of Attrition. This is formulated in the following proposition:

PROPOSITION 1.

The effectiveness of threats signalled by an aggrieved group has a basis in the unreliability of the signalling compared to international politics, whereby identification of the type of player based on Bayesian updating is corrupted and cannot provide the same increase in the level of information as in the standard audience cost model, thereby exploiting the model.

A more positive aspect on the potential for generating audience cost is when the aggrieved group is part of a peace solution, or at least taking part in negotiations to achieve a peace agreement. Kydd and Walter's (2002) extensive game with Bayesian updating and separating or pooling equilibria, analyses terrorist violence as a problem of trust. The lack of trust was a problem with the credibility of signalling

in the section above, but a peace negotiation is a distinct setting and signalling can be effective in determining the type of player, i.e. if the opponents are moderate or violent terrorists, weak or strong and trustworthy or not. Intriguingly, their observation goes against the audience cost model as well, in that *weak* moderates 'may be forgiven for failing to prevent terrorist attacks, but strong moderates will not' (Kydd and Walter, 2002:289). The moderates, bargaining with the government (see also next paragraph), may promise peace, thus signalling their intentions in the same manner as a state leader may do, but if they're weak, they won't have to pay audience costs (in full), because it is not expected that they could curtail extremists. Therefore, the incurred terrorist acts by extremists to avert a peace deal provide useful information not about the extremists themselves, but about the strength of the moderates on the moderates' capabilities to curtail the extremists. This leads to a paradox that weak moderates are better off in peace negotiations when there is an active violent faction, yet a weak negotiator achieves less in a bargaining process. Alternatively, is it like before exploitation of the model, in that an aggrieved group has an incentive to be perceived as weak, yet strong at the negotiation table? For why is it, that the combination violent terrorist and affiliated political party lasts longer then either one separately? If they were to be more effective when working in tandem or complementing one another's strategy, should they not only be capable of persisting longer, but also come to a resolve faster as they are "battling on two fronts"? I have no answer to this based on empirical data, but bargaining strength does shed some light on this (see §3.2). However, what it does imply according to Kydd and Walter, is an indicator for due audience costs when the negotiations involve a *strong* moderate aggrieved group: if violence does occur, the other player

infers that the moderates have been bluffing and not capable of keeping their commitments.

Third, when agreeing that aggrieved groups can build-up audience costs, albeit not in the same manner as in the standard international political scene, is this quantitatively measurable? This faces the same problems as Schultz (2001) discussed. An option to overcome this would be to rely on opinion polls; with all its imperfections not ideal either. Besides, establishing baseline credibility poses a problem, as well as (subjectively?) deciding if with every statement, bluff and lie the terrorist group should always be deducted equally[8] as the government. Intuitively, catching a bluffing democratic government seems more serious than a lying terrorist organisation, but this lies in the eye of the beholder as well as the parameters of the situation/game. Take for example a hostage situation: one subjectively may assume that a dishonest government lying to release hostages *might* be deducted less, i.e. incur lower audience costs, than unreliable hostage takers. Although according to Lapan and Sandler (1988:16), governments will lose reputation 'when governmental declarations are not completely credible and uncertainty characterizes the government's costs of not negotiating'. Thus a policy stance to never negotiate with terrorists is 'likely to be time inconsistent' (p16) and implausible, a factor affecting audience costs related to the terrorist theatre, but which *could* have less impact than unclear positions in the more regulated international political arena.

Concluding, in terrorist frameworks like peace negotiations, audience costs can be generated and identified, in the non-negotiation phase, aggrieved groups exploit the audience cost model to their own benefit, and audience cost modelling parameters,

[8] Calculated via the discount rate and factor of the war of attrition game.

especially the rate of deduction in crisis prolongation, depends on the problem being modelled and the preference of the modeller.

3. BARGAINING AND COALITIONS

The previous paragraph sidelined the actual bargaining and negotiation processes, important but its intricacies were not of primary concern. This paragraph will take a closer look at this facet. Coalitions can be part of a bargaining process, transforming the non-cooperative nature of bargaining to partial cooperation between a subset of the players, or all players into a "grand coalition", which may very well be brought forward via internal bargaining within the grand coalition until a unanimous vote is achieved.

Reiterating §1, two or more of the following list are involved actors, or players in the game: the aggrieved group (at least one, but may be more), primary state targeted, principal and accessory states and groups and (inter)national organisations. *Figure 1* shows their primary interrelations. However, I would not argue that e.g. there is no competition within an international organisation, but its *aim* is to work together and foster cooperation towards a grand coalition (like resolutions and common policy statements), more profoundly than bi- and multilateral interstate bargaining. Coalition governments are not applicable in a majority of cases, but do have an effect on the overall stage, e.g. in determining the strength and position of the EU as an international actor.

However, the first step is to deconstruct the interplay to its simplest form, to be extended later if and where appropriate.

Figure 1. Prevalent types of interrelations between actors

3.1 The Leviathan trap: ideologies, zero-sum and other ways out

Hobbes' pessimism on peace and the unavoidability of conflict is aptly illustrated by the Prisoner's Dilemma (PD), which invariably results in the rational outcome that harms both players, escaping conflict only by installing a 'sovereign, titanic Leviathan, to keep us all in awe'. I will refer to this combination of logic as the Leviathan trap, which lies at the heart to figure out 'how individually rational agents can avoid collectively irrational outcomes' and 'whether it is the character of the agents or their logic that holds the key to a theory of conflict'. (Varoufakis, 1991:37-41) One possible "escape" is denial of choice between the two alternatives in the game, which reduces the PD game to "choose between *I agree* and *I agree*", thus eliminating the bargaining. Indeterminate sustained force across the globe, required for the denial of choice, is not realistic now or in the near future; therefore, I discuss changes to the game model as potential or possible workable alternatives that can avoid mutual damage.

Imagine a normal form game, one-off or finitely repeated, with two players, the government and a terrorist, or a representative of the aggrieved group. Both may choose between a peace deal (or policy) that would contribute to either positive

peace or negative peace (the latter as 'absence of violence', or, according to Just War theory, as the 'presence of law and order').

Table 1 presents the payoff matrix and will have as outcome (*Negative peace, Negative peace*) with payoff of (3, 3), for the standard PD reasons, if there is not an unlimited level of trust between the government and terrorists. On can think of argumentations like "if I open up our organization and provide intelligence information, but all the other wants is finishing us, I will lose out, which is not going to happen" and "we don't get everything we want, but we make sure neither do you".

Table 1. Two types of peace deals

The values are numerical representations of a strategy, where the ratios of the values are important, not the actual numbers[9].

Table 2 presents an "improvement" on the PD, which is either a reality or maybe a mediator can convince the players they are not doomed playing out *Table 1*, but in a better position than inflicting mutual harm:

Table 2. A slightly modified "Prisoner's Dilemma".

Numbers in italics are in violation of the standard PD payoffs

The dominant strategy towards (*Positive, Positive*) in the payoff matrix in *Table 2* is rather obvious, though even a weak dominant strategy as in *Table 3* may be 'sold' to the negotiators via the power of persuasion as a preferable solution: a *win – win*

[9] The characteristic PD ratios are: temptation [for *Negative peace*] > cooperate [here *Positive peace*] > relative punishment [both *Negative*] > sucker [one *Positive* the other *Negative*].

scenario as opposed to a *win – win-much-less-than-your-opponent* situation, provided that the players can convince themselves they both have relatively good intentions (or a mediator may do so), taking advantage of 'cultural … perceptions and attitudes toward … symmetry, fairness and power' (Shubik, 1986:75). Note that this game demands a lower threshold for mutual trust to achieve (*Positive*, *Positive*) than the official Prisoner's Dilemma of *Table 1*.

Table 3. Payoff matrix with focal point and/or a basic level of trust.[10]

Numbers in italics are in violation of the standard PD payoffs

Another method of leaving the stage of a PD is to create it as in infinite game, where the players 'take into account the possibility that they will have to live with each other on the morrow' (Shubik, 1962:219), which fosters cooperation automatically (Axelrod and Hamilton, 1981)[11]. Fearon and Laitin (1996) use a similar model to explain interethnic cooperation, but add a few crucial aspects that the normal form game model cannot capture: important factors are individual reputation, "in-group policing" (group leaders punish their own people when they defect) and is linked to decentralised institutional arrangements. However, these institutions imply a level of self-governance, power sought after by aggrieved groups resorting to terrorist acts, and a (semi-) legal apparatus is a requirement to form enforceable 'binding agreements', which in turn is a prerequisite to make cooperative games workable. Reputation of each individual adds to a wider level of trust of the whole (ethnic)

[10] Note that the mentioned model outcome in bold text is not correct, as *Negative peace* is weakly dominant over *Positive peace*, due to the difference between payoff 1 for the government if (*Positive, Negative*) and 3 when (*Negative, Negative*). However, that difference is relatively small compared to the gains of (8, 8), the 'temptation'-factor for defection is absent, and it requires a lower level of trust between the players than a standard Prisoner's Dilemma.

[11] It is in this context that Varoufakis (1991) came to the conclusion as quoted at the start of this chapter.

group, and according to Ouardighi (2002), this social network is an even more important factor than enforceability or third party monitoring of agreements[12]. To summarize his game theoretical model (which uses a nonlinear differential system), where each of the players dynamically contributes within a joint production activity and encompasses responses to deviation, I include *Figure 2* and *Table 4* from his article as it neatly captures the gist of Fearon and Laitin as well.

Table 4. Strategic configurations of a partnership

Figure 2. Trust as a reactive attitude

It is tempting to hold both the figure and table against the various 'terrorist situations' and make predictions where on the axis and table cell the relationships lie, but within the limitations of this research, this would not exceed the level of an (informed) guesstimate, and therefore an interesting avenue for further research.

Aside from delving in externalities not covered in a standard normal form game and tinkering with payoffs, one can investigate the dualistic nature of the game, positive versus negative peace, modelling negotiations on the contents of peace agreements instead. In reality, horse-trading among the representatives (players) at the negotiation table does not reflect, as e.g. Putnam (1988) and Hosli (1999) indicate, equal gains and losses (zero-sum, see *Figure 3*) to achieve a peace deal, but scope for diversions. The crucial point is, peace bargaining does not occur

[12] Third party, external, monitoring of commitment is detrimental to trying to build mutual trust: if you trust the other faction(s) sufficiently, there is no need for a "nanny" to verify actions (Ouardighi, 2002). This is in stark contrast with e.g. Kydd and Walter (2003) and Walter (1997) who essentially preach the moral value of the use of an outside enforcer or monitor.

on single items but on combinations of points[13] and for one player to give in on some item, i.e. lose a little from his overall payoff to what he perceives as a minor issue, may be of greater value to her (e.g. an intangible 'moral victory'), giving her a higher extra payoff than he loses. *Figure 3* represents this higher level of flexibility. Although *Figure 4* is limited to the 2-dimensional space, the room for agreement (black) can be extended to partially overlapping spheres, cubes, pyramids and so forth.

Figure 3. One dimensional negotiation line, a zero-sum approach. S_G is the set of demands (flexibility in negotiations) for the government and S_T for the aggrieved group. (Figure based on Putnam).

Figure 4. Negotiation spaces, variable-sum: the amount one player can gain does not imply the equal loss in the payoff of the other player. Light grey + black is S_G and dark grey + black is S_T.

A rather curious game that escaped the Leviathan trap by using a dualistic approach is *Rationalizing Revolutionary Ideology* by Roemer (1985), using Russia with entrepreneurs Lenin and the Tsar as example (revolution has the broad definition as an allocation or redistribution problem). He modelled the transformation from PD into a zero-sum game purely because of the charisma and persuasion by one of the players, Lenin: by supporting him, people can avert the loss expected in a PD and turn it into the "sum" part of zero-sum. Bawn (1999:307) succinctly words it as strategic elites creating focal points around specific issues. With increasing levels of complexity of the mathematics of Roemer's game, it is possible to calculate how poor the peasants and how fierce the Tsar's penalties have to be in order to be able to

[13] For example, the Joint Declaration of the British and Irish governments as published in *The Irish Times*, 2-5-2003, p10-11, included sections on paramilitarism, policing and justice, rights, equality, identity and community, proposals for 'on the runs' and on monitoring and compliance.

be motivated to support the revolutionaries: *it is not ideology but just good strategy to incite a revolution*.

Bawn thinks ideologies[14] can arise out of self-interest and political bargaining and that an enduring ideology *must* be Nash equilibrium (Bawn, 1999:305); her game of ideology predicts that *inefficient* ideologies[15] will never be proposed because that implies that a player deviates from equilibrium strategy. These deviations are deemed irrational in the realms of game theory's analytical and instrumental reason (but see also *Appendix A* "the rational and irrational").

Alternatively, the disagreeing actors all could choose for a joint outside option to call in an international organization like the UN, EU or Transcend. This does have an effect on bargaining due to the fact that joint outside options are taken, in equilibrium, at out-of-equilibrium decision nodes, acting as a fallback for one of the parties. Thereby a new (extensive form) game is generated with *new* strategy sets, a highly interesting concept when bargaining peace agreements – to look for a third way. (Manizini and Mariotti, 1999) After all, in addition to play a game wisely, one can change it.

3.2 Broadening the models

[14] Bawn's definition of ideology: 'an enduring system of beliefs, prescribing what action to take in a variety of political circumstances' (1999:305).

[15] Inefficiency includes 'wasting time' on 'symbolic activities' and advocating 'clear lost causes' (pp324-325). Aggrieved groups resorting to instrumental reason, using any means to achieve your goal, rely considerably on symbolism and if a certain goal is a lost cause is highly debatable: that an aggrieved group does not have the military might to fight an overt war but resorts to terrorist acts does not mean that they're fighting needlessly for a lost cause.

The previous section looked primarily at elementary two-actor scenarios, which will be unravelled further (the bottom half of *Figure 1*) with sequential bargaining in an extensive form game and then extended to a multi-player stage.

Core game with two players, the government G and terrorists T. See *Figure 5*; either *G* can start with the game or *T*, which does not affect the essentials of the game. Here, *T* starts: the terrorists decide to continue using violence, or offer the government to negotiate over a peace agreement, the government can either accept or reject this peace offer. If the government accepts, then the terrorist can decide to go ahead with negotiations, or defect. Think of defection as the terrorists having deceived the government, to test if it is "soft" or not. The gamble of defection can mean either that the terrorists truly do not want to negotiate, or hoping that with more violence, the government may be even more willing to negotiate at a later stage, hence then the terrorist's intend is to create a better position for negotiations with the government at some time in the future. Conversely, substituting *G* for *T* and vice versa, a defecting government may decide that deceiving will help them gather intelligence to catch more terrorists, or e.g. end a hostage situation.

Else, terrorists do not offer to initiate peace talks, but subsequently the government can take the first step to indicate it is willing to initiate negotiations, which the terrorist can either accept or reject. Last, the government can respond to terrorist attack with counter-terrorism, here and in following figures considered as a policy of violence carried out by the government.

Figure 5. Core game with two players, the government G and terrorists T.[16]

[16] The allocations of probabilities follow standard procedure, *Negotiation offer* with probability p, *Attack* $(1 - p)$ and so forth.

However, neither the terrorists nor governments are homogeneous groups, thus one can divide the two players in *Figure 5* into four groups. This is represented in the next two diagrams. Of course, this does not mean that there are always two subgroups per group (player), but the primary point is that there is more than one actor involved in establishing the government's and aggrieved group's stance on policies that affect terrorists.

Core game where terrorists are divided between moderates, T1, and terrorists who want to continue using violence, T2. The assumption is made, that when moderate terrorists do not make a peace offer (to the government), the violent ones certainly will not do so and when *T2* joins the negotiation all will continue as outlined in *Figure 5*. If *T2* decides to disrupt an attempt by *T1* to initiate negotiation, *T1* decides either to continue its initiative to negotiate with the government or abandon its initiative. In this game, the government is an externality that does not affect the strategy of aggrieved groups. Bueno de Mesquita (2002) and Kydd and Walter (2003) use a similar idea, respectively by assumption and additional Bayesian updating.

Figure 6. Terrorists are divided between moderates, T1, and violent terrorists, T2

The "government" is divided into the party in government, Gg, and the opposition, Go. This can also be interpreted as a coalition government consisting of two parties who debate internally on their position regarding intended policy measures on terrorism (the upper half of *Figure 1*). The *Wants negotiation* and *Wants counter-*

terrorism are signals voiced by *Go*, as is *Support Gg* in the policy chosen by *Go* (*Figure 7*).

This game in *Figure 7* structures the audience cost model as an extensive form game, where, according to Fearon's definition, *Negotiation* is "backing down" and *Counter-terrorism* equal to 'standing firm', the latter building up audience costs. If *Gg* decides to go for *Negotiation* in the third round (indicated with an asterisk in the figure), it incurs audience costs. Likewise, if the audience costs would count "in reverse", the policy change by *Gg* in round three to *Counter-terrorism* (indicated with "**") would equally incur audience costs.

It is possible to substitute *Figure 6* and *7* fully into the first diagram, but this would obfuscate the essence of the game. Alternatively, there are options for the extensive form game to partially integrate *Figure 5* in a series of successive moves or to imagine the games happening in parallel. However, the former would make the model unnecessary complicated[17] and for the latter 'it is not possible to rely on standard solution concepts such as Nash's' (Horn and Wolinsky, 1988:485) because Nash's does not define compound bargaining.

Figure 7. Divided government, with a party in government, Gg, and opposition, Go

A step towards integration of the above models is to condense the matter to pure strategies in subgames with three players at each node: either a moderate, a hardliner and the government, or one generic terrorist and a non-unified government with an extra opposition party or a coalition government who do not share the exact same

[17] For the interested reader, an example is included in *Appendix B*.

strategy set. This model is as Chae and Heidhues (2001) outlined and to which I applied a generalization (*Appendix C*), {*T2, T1, G*} as:

(? *r* + (1- *r*)/4, ? *r* + (1- *r*)/4, (1- *r*)/2),

where *T2* denotes the payoff for the violent terrorist group, *T1* a stronger negotiating moderate and *G* the government. ? is the fraction players *T2* and *T1* have agreed upon that *T2* is worth in the coalition {*T2, T1*} (i.e. her share of the pie), if it is deemed viable to form one, and ? represents *T1*'s worth in the coalition. The breakdown point of the coalition, *r,* depends on the relative strength of *T2* and *T1*: in a non-cooperative situation with equal strength players *r* = ? , which is not a realistic assumption. In variable strength situations, this leads to the following proposition:

PROPOSITION 2.

In a 3-player game, {T1, T2, G}, where two players consider forming a coalition, this can be favourable in situations where the fallback position, r, is strictly lower than in a non-cooperative game, provided that the two coalition players divide the bargaining gains asymmetrically and both agree on the subdivision ratio.

Proof is published elsewhere (Keet, 2003). For example, a coalition between *T2* and *T1* as unequal partners dividing the bargained piece of the pie with a ¼:¾ ratio, it computes as a payoff of for {*T2, T1, G*} as (0.25, 0.375, 0.375), *thus a strong moderate terrorist can fare well by cooperating with a weak (smaller) hardliner*. Of course, the same is true in the case of one terrorist (representative) and two government players. Although at first impression the difference in payoff between *T2* and *T1* may seem unfair, due to a sense of inequity aversion (Fehr and Schmidt,

1999), but suffering this temporary loss to achieve a better result in the long run is rational (Brams, 2001), which Konishi and Debraj model 'by simply changing the discount factor of agents' (2002:3) and allowing for constant renegotiation of agreements[18].

Horn and Wolinsky (1988) investigated *when* factions should ideally form a coalition against a third player and when they should not, which they summarize in proposition 2 for labour unions, but can easily be adapted for {*T2*, *T1*, *G*}:

> PROPOSITION 3.
>
> *If the two sets of means and goals of the two aggrieved groups are sufficiently close substitutes, the equilibrium form of organisation is an encompassing group. If they are sufficiently complementary, the equilibrium form of organisation is separate groups.*

In case of sufficiently complimentarity and acting separately, they can virtually paralyse the government (the firm in Horn and Wolinsky's setting) because their bargaining position is stronger under separate organisations. The encompassing group follows aforementioned model of Chae and Heidhues (2001). The bargaining power of the government is not generally applicable for adaptation based on Horn and Wolinsky's applied model: the firm should divide and rule by geographically separating the workforce within and across countries. This has its analogue only in establishing smaller refugee camps in different locations with relatively difficult means of transport between them, making aggregation to form literally and

[18] They test deterministic and stochastic schemes, slightly different from game models discussed in this and previous chapter.

figuratively "one front" among the dispersed refugees more challenging, or even impossible. Illustrative examples of the potential of applicability are the Palestinian and Afghan refugees. Palestinians reside in smaller refugee camps[19] spread over different countries in the Middle East and have a far from united front. Afghan refugee camps in Pakistan with over 2 million refugees per camp is said to have been fertile ground for Taliban and, later, Al-Qa'ida recruitment[20].

Aggrieved groups may not only form a coalition, but consist themselves of coalitions as well, either as umbrella organization or as a group of individuals, i.e. an alliance (graphically represented in *Figure 8* and *Figure 9*).

Figure 8. Intracoalition bargaining options within an alliance. Safe/Unsafe indicates if there is a 'fallback' option for a member of the alliance. (Based on Manzini and Mariotti, 2001)

Figure 9. Power distribution within an alliance.

Game models predict different degrees of effectiveness of such alliances. Hosli (1999) and Putnam (1988) focus on the "capacity to act", which is supposedly lowest when the alliance uses unanimity procedures and improves with qualified majority; even more so with simple majority voting. However, strength of negotiation tactics with other players has a correlation in the opposite direction: alliances based on unanimity fare best (Manzini and Mariotti, 2001), presumably because a representative of the alliance at the negotiation table feels "stronger" as he is assured that what he bargains for is what all members want most. Combining the two ideas,

[19] E.g. Shatila and Ain-El-Helwe in Lebanon with roughly 200,000-400,000 people.
[20] Presentation, d.d. 11-4-2003, by Rifat Iqbal, Pakistani Ambassador to Ireland, on invitation by the Irish Peace Society, Limerick, Ireland.

one can infer "slower, but more robust" and "quicker response, but less social basis in the grass roots support". The former may take longer than the patience of the players (representatives and alliance members) or not demand enough when the strategy set (negotiation space) is a lowest common denominator consensus, the latter has a higher probability of breaking down after some time because of less than full support. The crux is, which one is prevailing in what situation, aside from defining fluid concepts as slow and quick. The latter depends on the perception of the involved actors, but when there are negotiations and the actors cannot agree within a given deadline, though see options and are unanimity-based, it is reasonable to categorise the negotiation process as too quick. It is widely accepted within peace research that working with deadlines has a negative outcome on peace negotiations and processes; these discussed models provide a game theoretical explanation why this is observed in the field[21].

Another problem may arise during negotiations when we take a situation with two players, government and aggrieved group, where each is subdivided in parties/factions and individuals, when one is of the slower qualified majority or unanimity type and the other would like to hammer out a peace deal in a relatively short time span. Being able to identify such a situation, based on the organisational or institutional arrangements involved, may alleviate some of the frictions and aid mutual understanding for their respective inner workings of the faction, hence aid towards a positive outcome of negotiations.

[21] In addition to the previously discussed finite/infinite Prisoner's Dilemma. A deadline can be interpreted as a finite PD, hence subject to end of game pathologies; no deadline as pretending it is an infinite game.

5. THE (NON?)SENSE OF GAME THEORY

In the preceding paragraphs several game models passed the revue: none is capable of describing a general model for terrorist situation, but this is certainly at least partially due to the plethora of situations, causes and involved actors described as terrorism. However, it does provide insight into aspects of the terrorist theatre, ranging from exploitation of the audience cost model, the increase of violence during peace negotiations (including providing new information to the actors), options to escape the mutual harm of the Prisoner's Dilemma, potential for coalition-forming and offers an explanation for unconstructive deadlines and actors in two-speed negotiation processes.

Without going into too much detail of myriad of cause of terrorism[22], some are more suitable for modelling than others:

- Ethnicity, nationalism/separatism: success of cooperation is linked to in-group policing a level of self-governance. It does not answer the minimum required levels of these two parameters to achieve peaceful co-existence. The trust factor provided an explanation from another angle.
- Poverty and economic disadvantage, globalisation: violent struggle can be a rational, "good" strategy if the individuals are sufficiently poor, have a charismatic leader to lead the people and the government's punishment system is sufficiently harsh; the "critical mass" for revolt can be calculated.

[22] Both cause and goals of terrorism are elaborated on in the author's MA dissertation *Terrorism and Game Theory* (Keet, 2003).

- (Non-)democracy: no conclusive answer. There are factors like poverty and ethnicity to be taken into account (see previous points). Democratic leaders ought to be better capable of signaling their intentions, hence alleviating the information asymmetry and thereby lowering the chance of conflict.
- Western society: not addressed. See also religion further below[23].
- Disaffected intelligentsia: not sufficiently addressed. One could consider the stance to negotiate with aggrieved groups as an outlet for intelligentsia. There are conflicting results on the effects of ideology (either narrowed down to economic motives, or considered as inefficient).
- Dehumanisation: not addressed. Modelling dehumanisation opens the complex issue of "psychological game theory", an undeveloped area in game theory.
- Religion: may be considered as a component of an ethnic group, but did not receive attention separately. Religion, and its norm and belief system, does have an effect on usefulness of the focal point concept, which could be exploited to avert the mutual harm of the Prisoner's Dilemma game.

Testing some of the possible goals of the aggrieved groups for potential with game theory, especially in the sense of goal as possible strategy set, the following observations can be made:

- Power: a quest for power, being it absolute winning or equilibria where both win, i.e. gain a share in power, is exceedingly suitable for game modelling.
- Implementing ideology: there are conflicting views on modelling ideology, which allows for further exploration of the topic.

[23] Whereby 'Western society' is considered to be based predominantly on Christianity (variations on Protestantism and Catholicism), as religion as well as the prevalent norms and beliefs system.

- Territory: this can be interpreted as a strategy for power, but also parameterised as indivisible or public good bargaining analogous to economics games.
- Evangelisation of religion: converting people, in the abstract sense a process of enlarging one's grass roots, does not lend itself for game theory because it is a *process* and not an outcome (see next section).

The Nash equilibrium is an appealing concept to use, because the definition states that it is, as Voltaire (1758) centuries before wrote, the best of all possible worlds [for all players]. However, this overlooks that the equilibrium is an existence result, but does not provide directions on how to define payoffs that accurately reflects the situation being modelled. Further, over-focussing on equilibria culminates in notions of e.g. "inefficient ideologies" that will not be chosen as strategy because they are not in equilibrium, something that the game designer has designed herself, which is circular reasoning and does not provide an explanation. How to explain a player's conjectures for the decision to chose a strategy off the equilibrium path? Is he a "rational fool" or irrational? Maybe the analytical and instrumental reason of positivism that lies at the heart of game theory cannot live up to the intricacies of social relations? Varoufakis (1991) provides an illuminating discussion on this and related factors if off-equilibrium choices are rational, hence suitable for (game) modelling, or irrational, and I provided an example in *Appendix A* where an apparently irrational move starting violent conflict could be rational in retrospect. These points could suggest that the route (process) to the destination (solution) is more important than the payoff/utility (Shubik (1987) and Varoufakis (1991)), although, shown in this chapter,

> As with any mathematical theory of human behavior, utility theory does not always successfully predict the decisions that people make, but it is a compelling and general theory that can account for much observed behavior. (Meyerson in Raptis, 2002)

As Varoufakis (1991:278) concludes, by which I agree, '*conflict is not only compatible with Reason; it is the only rational response to primitive social relations*', which means that game theory can be a useful tool to contribute to the research and resolve of terrorism.

6. CONCLUDING REMARKS AND FURTHER RESEARCH

Examining the possibilities of the various models of game theory, variable-sum normal form games, like mutations of the Prisoner's Dilemma can capture basic elements of negotiations between aggrieved groups and the government and an adjusted War of Attrition is suitable for modelling audience costs. Extensive form games disclose interactions between actors in a structured format. Cooperative games reveal interesting features of coalition-formation and strengths and weaknesses in negotiation processes.

In a 3-player game, where two players consider forming a coalition, this can be favourable in situations where the fallback position is lower than in a non-cooperative game, provided that the two coalition players divide the bargaining gains

asymmetrically and both agree on this asymmetric subdivision ratio. I have proved that a strong moderate terrorist can fare well by cooperating with a weak (smaller) extremist faction (the same holds for the case of one terrorist (representative) and two government players of unequal strength). Further, if the sets of means and goals of the two aggrieved groups are sufficiently close substitutes, the equilibrium form of organisation is an encompassing group; if they are sufficiently complementary, the equilibrium form of organisation is in separate groups. When the former is applicable, a government would benefit from the "divide and rule" tactics by distributing refugees into smaller groups in geographically distinct areas to avoid cooperation against an oppressor.

Deadlines have a negative outcome on peace negotiations and processes; the discussed models provide a game theoretical explanation why this is observed in the field based on the internal dynamics of the actors (organisations/government). This also indicates that when one can identify a situation with 'two-speed' actors, based on the organisational or institutional arrangements involved, it may alleviate some of the frictions and aid mutual understanding for their respective inner workings, hence aid towards a positive outcome of negotiations.

In terrorist frameworks like peace negotiations, audience costs can be generated and identified, in the non-negotiation phase aggrieved groups exploit the audience cost model to their own benefit, alike a War of Nerves. Modelling audience cost parameters, especially the rate of deduction in crisis prolongation, depends on the problem being modelled and the (subjective) preference, or moral bias, of the modeller.

Therefore, Game theory is a useful tool in rationalising the emotion-laden field of terrorism, and has provided insight in the intricacies of the audience cost model, the increase of violence during peace negotiations, options to escape the mutual harm of the Prisoner's Dilemma, potential for coalition-forming and offers an explanation for unconstructive deadlines and actors in two-speed negotiation processes. Although several of the uncovered aspects will need to be verified with empirical data, at the present stage it already aids understanding, which is a first step towards resolution of conflicts, but one can never include all terrorism-related aspects into one model because of the controversies surrounding the concept "terrorism".

Although the conducted research did clarify aspects of the terrorist theatre, it also opened new areas one can explore for further research.

I addressed the game theory of cooperative structures with regard to internal group dynamics related to unanimity and majority positions on a theoretical level, which would benefit from a closer analysis of terrorist organisations and cells to put the ideas to the test on how they reach a policy stance and if it indeed affects negotiations in the way as predicted by the theory. Possibly related are aspects involving the logic of collective action, peer pressure and internal motivation of the terrorist. Overall, this could shed light on deadline- and two-speed negotiations and sustainability of a peace agreement by their grass roots, whether from the aggrieved group, government or the wider public.

The audience cost model could not be used to assess build-up of audience costs within aggrieved groups due to a lack of sufficient information, though it would be highly informative if Crenshaw's (1991) idea of organisational disintegration were

related to a leader who incurred audience cost due to making false promises to his group members could be tested and how these audience cost are 'paid' when there are no elections, or if there are other more important reasons.

The dynamics of inter-group and state relations is underexposed. Although several examples of negotiations exist, at present most notably Northern Ireland and Israel/Palestine, there is a strong US voice to be "tough on terrorism" (despite existing "quiet diplomacy" of negotiations with aggrieved groups, e.g. USA with Hizbollah), which does not aid in "openly" researching the matter. However, a better understanding of these dynamics could help actors involved in other protracted conflicts to set out their respective policies. These envisaged case studies could provide information in order to determine probabilities of the extensive form games to update either the mixed strategy or typing of players via Bayesian updating, which in turn serves (more accurate) prediction of behaviour in these conflict situations.

Ouardighi's (2002) model of trust should be put to the test, i.e. one can asses the various conflicts on this dimension, which could reveal if requests by one faction to "just trust us" and another choosing vigilance is rational or purely emotion-based. Additionally, it might reveal if external monitoring fosters trust, or if it is indeed harmful as Ouardighi devised.

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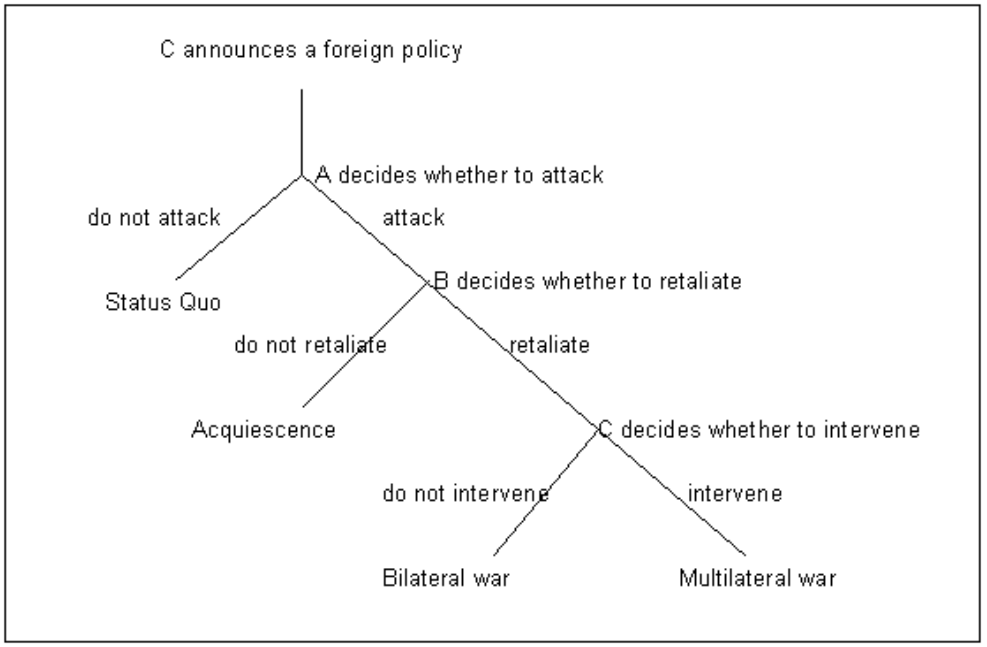
APPENDIX A - THE INTERNATIONAL CRISIS GAME

(source: Smith, 1998:624)



Explanation of the diagram

There are three nations, A, B and C. A has a dispute with B and C, where B and C agree over the status quo. A has the sole options to either attack B or stay disgruntled. B can decide to give in to A and A achieves its desired policy, or B can retaliate and will be successful with some probability. Once the war between A and B is ongoing, C decides to intervene or let A and B continue with their bilateral war. Form B's perspective, a multilateral war involving C is more favourable as it would provide them with moral and physical support to try to maintain their status quo. This knowledge has an effect on B's behaviour: if it expects C to intervene, it may be more inclined to resist. Idem ditto for state A: if A thinks C will intervene, it may be less inclined to initiate the fight with C due to a smaller probability of success. (Smith, 1998)

An extension of this idea is for example imagining C as a (former) superpower and B fighting the (one-sided proxy) war on behalf of C against A. Alternatively, for example acquiescence by Lebanon regarding Syria's presence in the country.

The rational and irrational

Say, B is militarily superior to A and both know this, but A feels it is unfairly treated by B, or desires land and/or statehood, and does not approve B receives support from C. From a rational game theoretical equilibrium perspective, A should not attack B but seemingly 'irrationally' does so anyway. This is an off-equilibrium strategic move, and with A having insufficient military strength, its people resort to terrorist acts. Subsequently B retaliates by a show-off of its military strength, with either accessory or principal support by C. However, remind yourself it is exactly the unfair treatment A disapproved of and the lopsided response by B and C is actually proving their case, thus their initial (subgame) off-equilibrium attack against B becomes rational in the nonmyopic (farsighted) multi-stage extensive form game.

One can easily think of A = Palestine or Lebanon, B = Israel, C = USA or A = Euskadia (Basque region), B = Spain and C = USA/EU.

Despite this realistic scenario, game theory does not lend itself well to accurately represent this type of switching from irrational to rational strategies: in principle, a set of feasible strategies does not contain irrational moves and one cannot update the strategy set 'in hindsight'.

APPENDIX B - EXTENSIVE FORM GAME

Example of a more (too) complicated game, with players government, G, moderate terrorists who are willing to negotiate (initially), T1, and more violent-minded terrorists, T2.

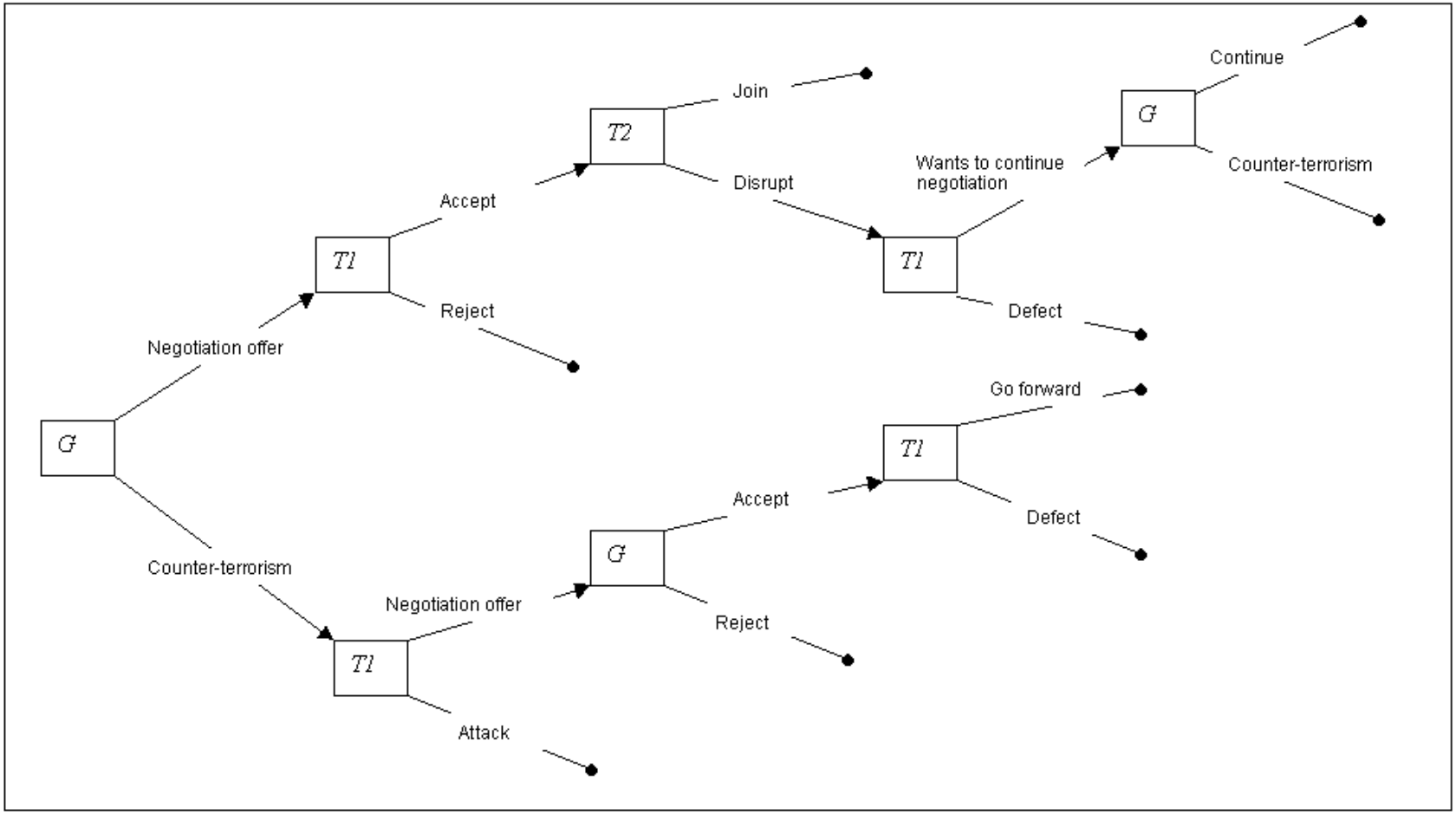


Figure 1. Prevalent types of interrelations between actors

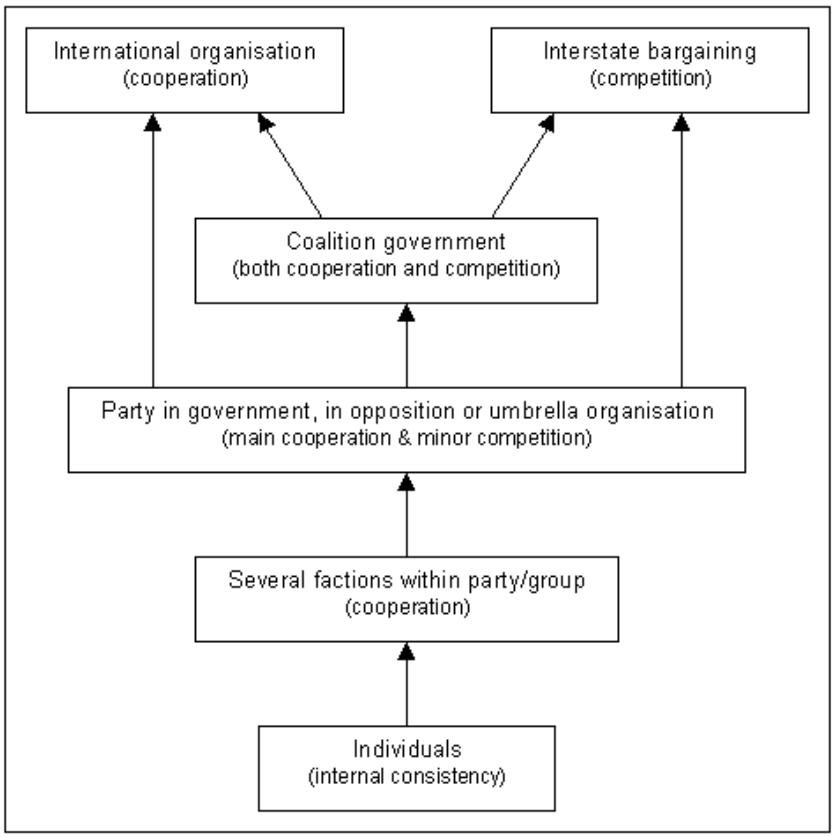


Table 1. Two types of peace deals

		Terrorist		
		Positive peace		*Negative peace*
Government	*Positive peace*	8, 8	→	1, 10
		↓		↓
	Negative peace	10, 1	→	**3, 3**

The values are numerical representations of a strategy, where the ratios of the values are important, not the actual numbers[24].

[24] The ratios that are characteristic of a PD: temptation [for *Negative peace*] > cooperate [here *Positive peace*] > relative punishment [both *Negative*] > sucker [one *Positive* the other *Negative*].

Table 2. A slightly modified "Prisoner's Dilemma".

		Terrorist		
		Positive peace		*Negative peace*
Government	*Positive peace*	**8, 8**	←	1, *7*
		↑		↑
	Negative peace	*7*, 1	←	3, 3

Numbers in italics are in violation of the standard PD payoffs

Table 3. Payoff matrix with focal point and/or a basic level of trust.[25]

		Terrorist		
		Positive peace		*Negative peace*
Government	*Positive peace*	**8, 8**	↔	1, *8*
		↕		↑
	Negative peace	*8*, 1	←	3, 3

Numbers in italics are in violation of the standard PD payoffs

[25] Note that the mentioned model outcome in bold text is not correct, as *Negative peace* is weakly dominant over *Positive peace*, due to the difference between payoff 1 for the government if (*Positive, Negative*) and 3 when (*Negative, Negative*). However, that difference is relatively small compared to the gains of (8, 8), the 'temptation'-factor for defection is absent, and it requires a lower level of trust between the players than a standard Prisoner's Dilemma.

Table 4. Strategic configurations of a partnership

		Historical context	
		Low familiarity	*High familiarity*
Social context	*Mutual vigilance*	Crisis	Doubt
	Mutual trust	Sympathy	Merger

Figure 2. Trust as a reactive attitude

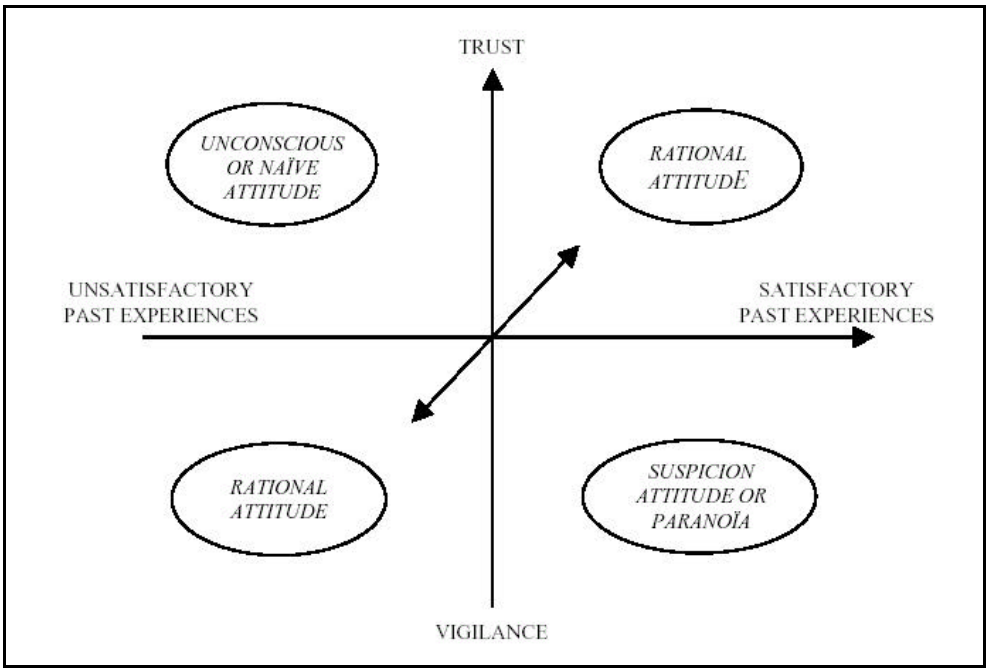


Figure 3. One dimensional negotiation line, a zero-sum approach. S_G is the set of demands (flexibility in negotiations) for the government and S_T for the aggrieved group. (Figure based on Putnam, 1988).

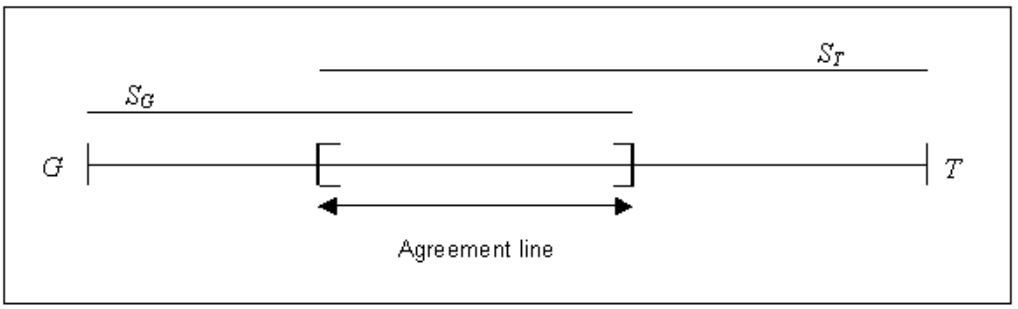


Figure 4. Negotiation spaces, variable-sum: the amount one player can gain does not imply the equal loss in the payoff of the other player. Light grey + black is S_G and dark grey + black is S_T.

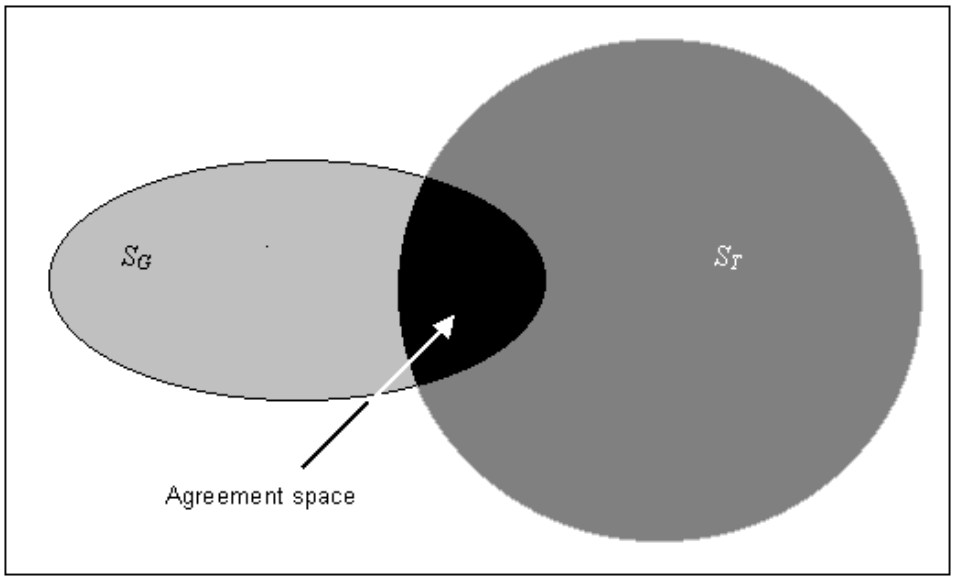
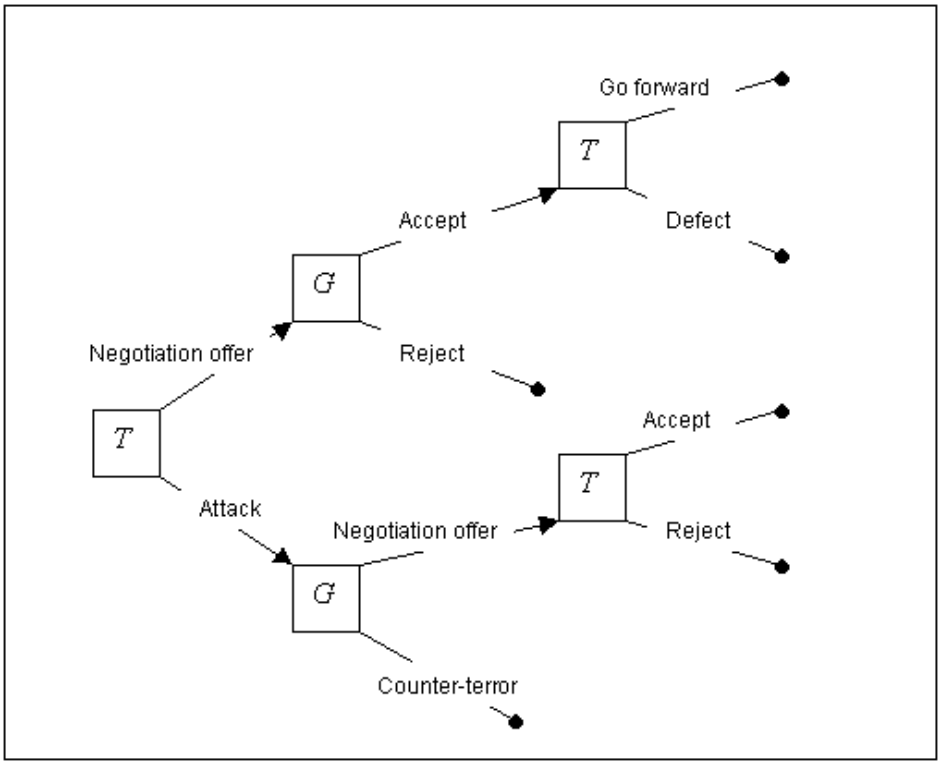


Figure 5. Core game with two players, the government G and terrorists T.[26]



[26] The allocations of probabilities follow standard procedure, *Negotiation offer* with probability p, *Attack* (1 - p) and so forth.

Figure 6. Terrorists are divided between moderates, T1, and violent terrorists, T2

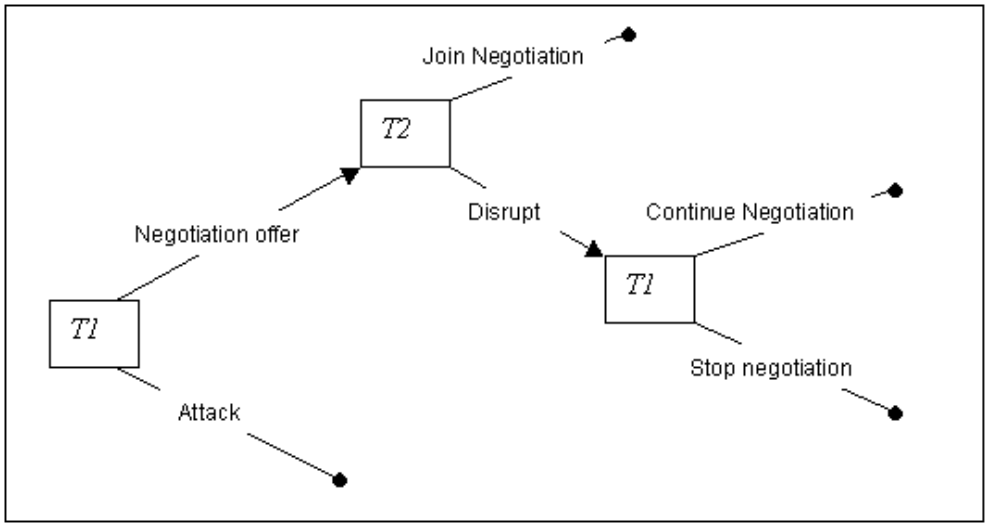


Figure 7. Divided government, with a party in government, Gg, and opposition, Go

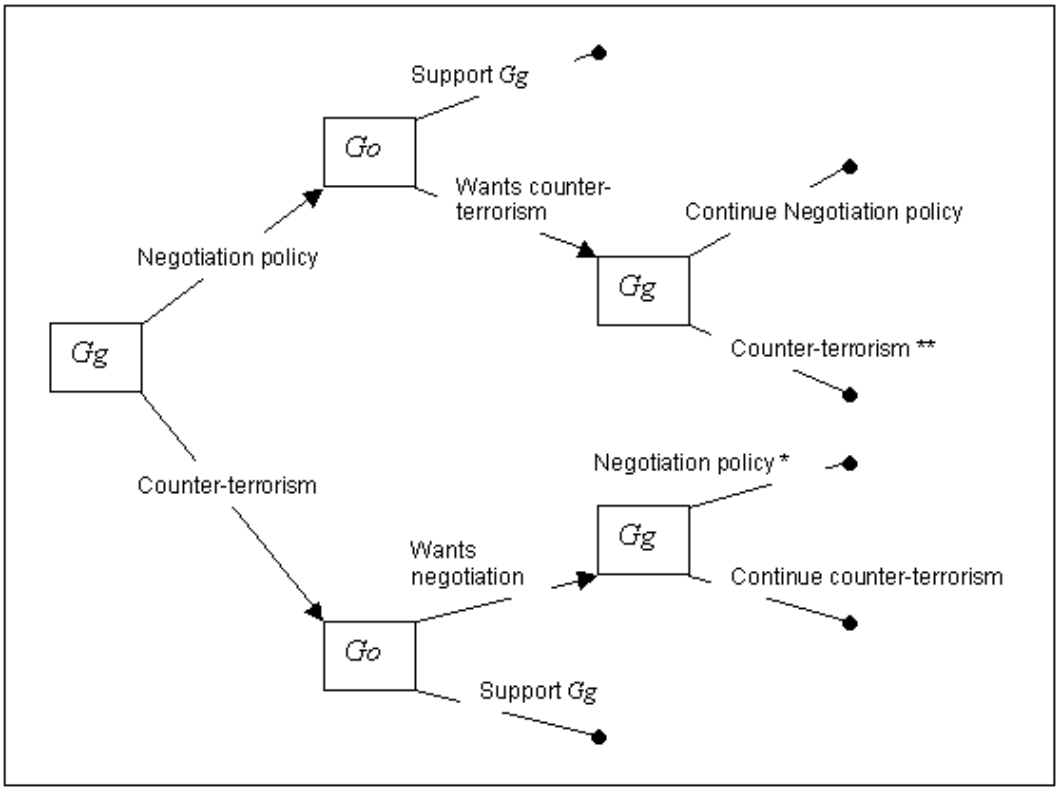


Figure 8. Intracoalition bargaining options within an alliance. Safe/Unsafe indicates if there is a 'fallback' option for a member of the alliance. (Based on Manzini and Mariotti, 2001)

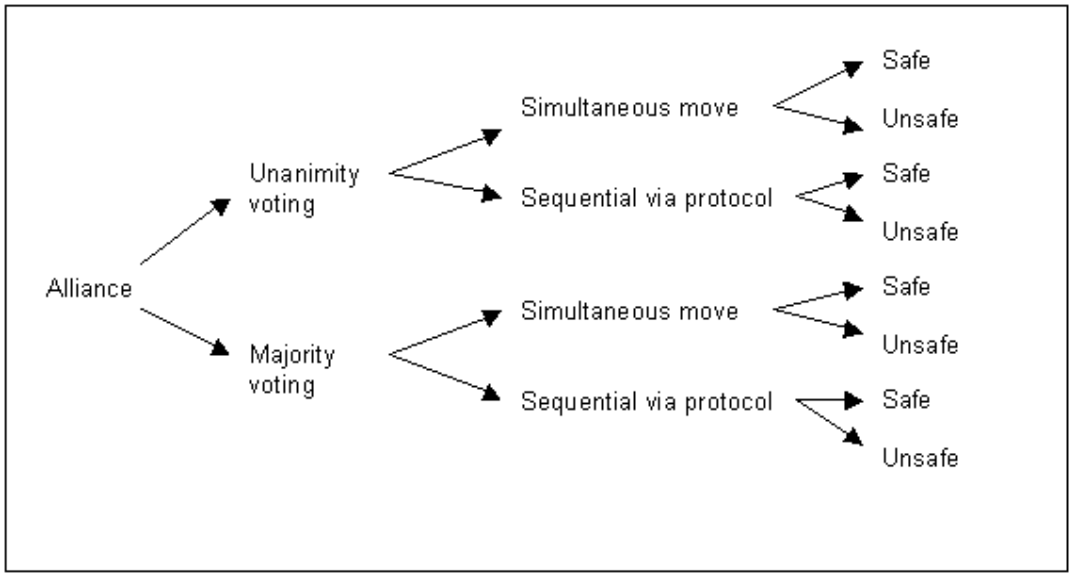


Figure 9. Power distribution within an alliance.