Modeling Decision-Making Outcomes in Political Elite Networks

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Abstract. A methodology for modeling group decision making by political elites is described and its application to real-world contexts is illustrated for the case of Afghanistan. The methodology relies on the judgments of multiple experts as input and can improve analysis of political decision making by elucidating the factional structure of the group of elites and simulating their interaction in a policy debate. This simulation is performed using a model of small group decision making which integrates actor policy preferences and their inter-relationship network within a nonlinear dynamical systems theory framework. In addition to the basic nonlinear model, various components required to implement the methodology are described such as the analyst survey, structural analysis, and simulation. Implementation and analysis results are discussed for both the government and insurgent sides of the current conflict in Afghanistan.

Keywords: political networks, social networks, computational social science, nonlinear dynamics, Afghanistan.

1 Introduction

This paper describes a methodology for quantitatively modeling group decision making by political elites. The methodology involves the use of expert judgment as input, structural analysis, and computational simulation using a nonlinear model of small group decision making which can address questions involving the outcome and level of dissent in a given policy debate. The methodology can aid analysis of group decision making by providing both a quantitative and qualitative framework. Quantitative implementation affords a systematic framework for assessing the interaction of member policy preferences and inter-relationships. This is difficult to do on a purely qualitative level as the structure of the group's social network and distribution of policy preferences may be complex — a difficulty that is compounded by the nonlinear nature of the interaction between group members. As a qualitative framework, the model of group decision-making dynamics can provide guidance as to when one should be on guard for the possibility of "nonlinear behaviors" that can lead to sudden and dramatic changes in policy or group discord or to unanticipated, perhaps counterintuitive dynamics.

This paper proceeds as follows: Section 2 presents the nonlinear model of group decision-making dynamics. In Sec. 3, the implementation methodology is

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described. Section 4 illustrates the application of the methodology for the current conflict in Afghanistan for both Afghan government and insurgent leadership groups.

2 Nonlinear Model of Group Decision Making

This section describes the nonlinear model of small group decision making which is used to simulate the evolution of group member policy or ideological positions [8,7]. The theoretical basis of the model draws from social psychology theories of attitude change and small group dynamics and theories of foreign policy decision making [1,17,15]. The model is concerned with the evolution of group member positions for a given policy issue or broader ideological axis. The group member policy positions are arrayed along a one-dimensional continuum known as the *position spectrum*. A group member's position along the position spectrum is subject to change under the influence of three separate forces: (i) the self-bias force; (ii) the group influence force; and (iii) the information flow force. Only the first two forces will be discussed in this paper but information flow force has been used to model interactions between two rival decision-making groups and as a stochastic forcing representing random flow of incoming information.

2.1 Self-Bias Force

For a given policy decision episode, each member comes to the debate with his own preferred position called the *natural bias*. It is a reflection of the member's underlying beliefs, attitudes, and worldview of relevance to the matter at hand. If a member's position is shifted from his natural bias due to group pressures, he will experience a psychological force that resists this change. This self-bias force can be viewed as a form of cognitive dissonance [1]. Denoting the i^{th} member's current policy position by x_i and his natural bias as μ_i, then i's self-bias force $S_i(x_i)$ is proportional to the difference between his current position and natural bias,

$$S_i(x_i) = -\gamma_i(x_i - \mu_i). \tag{1}$$

The proportionality constant γ_i is called the *commitment*.

2.2 Group Influence Force

The group influence force is the total force acting to change a member's position due to the other members of the group. The influence of member j upon member i is assumed to be a function of the difference in their current positions, denoted by $H_{ij}(x_j - x_i)$ and called the *coupling force*. In general, the reciprocal coupling forces between two members will not be of equivalent strength, $|H_{ij}| \neq |H_{ji}|$. If there are N members in the group, the total group influence force on member i, denoted by $G_i(x_i)$, is given by the sum

$$G_i(x_i) = \sum_{j=1}^{N} H_{ij}(x_j - x_i). \tag{2}$$

The coupling force, depicted in Fig. 1, is taken to have the form,

$$H_{ij}(x_j - x_i) = \kappa_{ij}(x_j - x_i) \exp\left(-\frac{(x_j - x_i)^2}{2\lambda_i^2}\right), \tag{3}$$

where κ_{ij} is the *coupling strength* and λ_i is i's *latitude of acceptance*. κ_{ij} gives the strength of the influence of j upon i given their personal relationship and is equivalent to a tie strength in a weighted adjacency matrix ($\kappa_{ij} \geq 0$, $\kappa_{ii} = 0$). It is useful to define a *coupling scale* α which is equal to the average coupling strength, $\alpha = \sum_{i,j} \kappa_{ij}/N$. The coupling scale can be used to represent the overall group cohesion stemming from factors such as the frequency of communications between members, their camaraderie and dedication to the group, and the overall threat to the group.

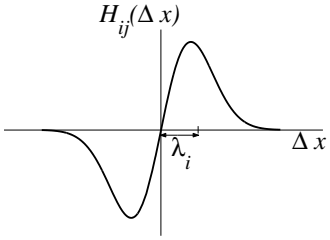

Fig. 1. Plot showing the nonlinear dependence of the coupling force on the inter-member opinion difference. $\Delta x = x_j - x_i$.

2.3 Equation of Motion

The sum of the self-bias and group influence forces determines the rate of change of the i^{th} member's opinion so that $dx_i/dt = S_i(x_i) + G_i(x_i)$. Using the expressions (1)–(3) then yields the following equation of motion for each of the group members:

$$\frac{dx_i}{dt} = -\gamma_i(x_i - \mu_i) + \sum_{j=1}^{N} \kappa_{ij}(x_j - x_i) \exp\left(-\frac{(x_j - x_i)^2}{2\lambda_i^2}\right). \tag{4}$$

With regard to formal models of group decision making, this model is most similar to "social influence network theory," a linear model in which the force producing opinion change in a dyad is always proportional to the level of disagreement [5]. The nonlinear model of Eq. (4), however, has both a "linear" regime at low disagreement levels in which the behavior is intuitive and a "nonlinear" regime at high disagreement levels in which behaviors can run counter to initial intuition. The linear regime is characterized by: gradual changes in policy outcomes and the level of equilibrium group discord as parameters such

as the coupling scale are varied; only one equilibrium for a given set of parameter values; lower group discord for higher network tie densities; and symmetric conditions of opinions and couplings always lead to symmetric final states. The nonlinear regime can exhibit the opposite behaviors: discontinuous transitions between deadlock and consensus as parameters are varied; multiple equilibria for a given set of parameter values; greater discord reduction in less dense networks; and asymmetric outcomes of majority rule even for symmetric conditions [8,7,13].

3 Implementation

This section describes the methodology for implementing the model on real-world, ongoing political contexts based on input obtained from analysts with expertise on the situation of concern. An overview of this methodology is depicted in Figure 2.

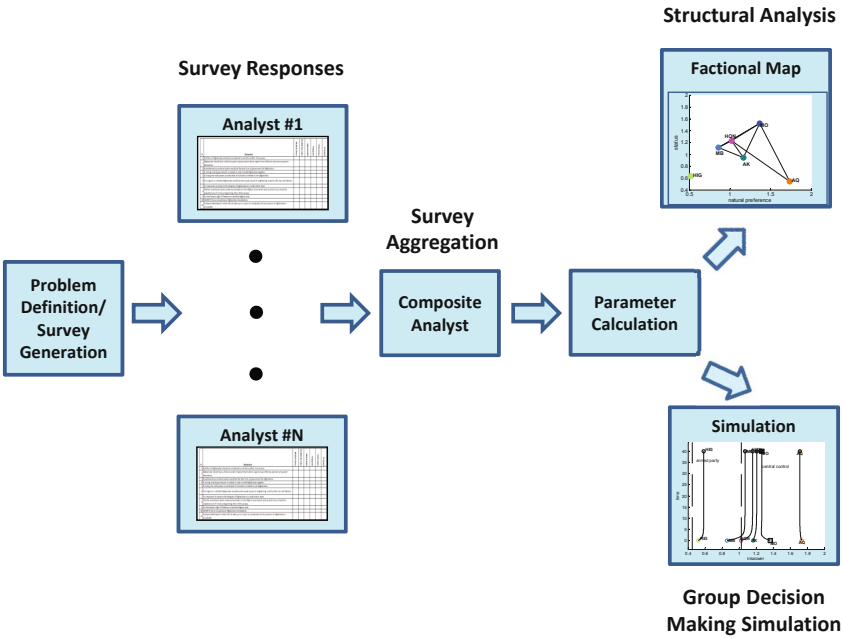

Fig. 2. Overview of Methodology

3.1 Problem Definition and Actor Selection

Problem definition concerns identifying the policy issue(s) of concern and the actors who will comprise the members of the decision-making group that will be modeled. The model assumes that relationships are stable during the course of the decision-making episode. It also assumes that group members are on the

same "team" in that they have important common goals which can be furthered by joint, coordinated action and that their fates are tied together by the success or failure of that action. Accordingly, the policy issue to be modeled should be one in which the achievement of common goals is at stake. This speaks to choosing issues which are core to the success of the group. This can also be achieved by using a broader ideological axis which represents a combination of multiple issues for the position spectrum.

Typically, the members of the decision-making group are individual elites whose policy stances and relationships are critical to the decision-making process. The use of individuals is consistent with the basis of the model in social psychology, although there is no reason based purely on the model formalism which precludes the use of groups or organizations as actors.

Selecting the political elites to include in the model is often difficult given the need to limit the number of actors. This limit does not stem from computational demands of the model but rather practical demands on analyst time for survey completion. A limit of twenty actors seems reasonable based on having a survey that can be completed within a few hours. Another practical factor limiting the size of the group is that it appears to be rare for analysts to have knowledge of a large number of actors at the resolution required by the survey. In addition, a large number of actors can also excessively complicate model interpretation and visualization without significantly improving the analytical value.

Actor selection is most straightforward in situations where there is a formally-constituted small group for making decisions such as the Politburo Standing Committee in China or the General Secretariat of the FARC rebel group in Colombia. In cases where there is no such group, it may be helpful to include actors on some common basis such as having an independent power base external to the group, e.g., bureaucracies, political parties, militias, religious institutions, and tribes (see Sec.4.1).

3.2 Analyst Survey

This section describes the components of the survey which elicits expert judgment on the political group under study. Not all of the components below need to be included in every survey but the Ideologies and Strategic Attitudes and Influence Matrix components are essential.

Ideologies and Strategic Attitudes: This component of the survey is designed to assess the attitudes of the group members relevant to the policy issues of concern. It is used to calculate member natural biases and latitudes of acceptance and to set the intervals along the position spectrum corresponding to different policies. For each member, analysts are asked to estimate the member's level of agreement/disagreement with a series of statements on a scale ranging from 1 (Strongly Disagrees) to 5 (Strongly Agrees). The instructions direct analysts to evaluate agreement with the statements on the basis of the private beliefs of the members if thought to be at odds with their public rhetoric. The statements cover a range of issues, goals, identities, and specific policies. Examples are shown in Table 3.

Influence Matrix: For the influence matrix, analysts are asked to estimate the strength of each person's direct influence, i.e., that resulting from direct verbal or written communications (perhaps via trusted intermediaries), upon each of the other members in the group. The influence strength depends on factors such as the frequency of communications, status within the group, common or rival factional membership, and personal relationships of friendship or animosity. The influence strength is scaled on a range from 0 (None) to 4 (Very Strong). Each pair of members is represented by two cells in the matrix: one corresponding to influence of i upon j and one for j upon i. The influence matrix values are used to calculate the coupling strengths and commitments.

Status: Analysts are asked to rate the "status" of each group member on a scale from 1 to 10. Status is an estimate of the power of the elite in terms of his ability to influence others within the group. It depends on factors such as his formal rank within the group, the strength and nature of his power base, the amount of resources he controls, and the respect accorded to him. It is used in calculating the policy that emerges from the weighted majority and consensus decision rules and in the factional maps.

Group Affinity: A member's group affinity refers to the extent to which his allegiance resides within the leadership group as opposed to something outside the group such as the organization that he commands or to his ideology. It gives a measure of the degree to which the member will put aside his own personal policy preferences for the sake of preserving group unity. The group affinity is akin to the concept of "primary group identity" used in the decision units framework for foreign policy analysis [16]. The group affinity is scaled from 0 to 1 where 0 signifies total disregard for the opinions of the other group members and 1 signifies that the member is completely concerned with the positions of the others and ignores his own natural bias. Group affinity can be used to calculate the coupling scale.

Decision Rule: The decision rule is the way in which the final positions of the group are combined into a policy decision. Three possible choices are used:

- *Leader Choice:* The chosen policy is the final position of the group leader.
- *Weighted Majority:* The policy supported by the highest status subset of group members wins.
- *Consensus:* All group members must support the final policy. If no consensus policy exists, the status quo policy is the default.

Confidence Level: This component asks the analysts to assess their level of confidence in their knowledge of each of the actors with respect to the information solicited by the survey. A scale of 1 to 4 is used where 1 is "minimal confidence" and 4 is "high confidence." These scores are used in aggregating the analyst surveys to form the composite analyst.

3.3 Survey Aggregation

A composite analyst can be formed by averaging the survey responses of the individual analysts. If desired this can be done in a weighted fashion so that an analyst's answers are weighted by her confidence level for each actor. The aggregation of individual surveys allows for analyst judgments to be synthesized independently of each other, thereby minimizing the chances of social pressures altering individual judgment as can happen if the modeler elicits inputs in an oral discussion with a group of analysts. Note also that results can be generated on the basis of individual surveys as well. This allows for the comparison of the results from individual analysts with the composite analyst and with each other, thereby providing a way of stimulating debate about differences between analyst viewpoints.

3.4 Parameter Calculation

Some parameters can be essentially taken straight from the survey whereas others involve more elaborate calculation. Only the natural bias and latitude of acceptance calculation are noted here.

The natural bias for a given issue is the overall attitude score of a member for that issue which is obtained by averaging the member's responses to the relevant statements for that issue (after flipping those statements phrased to indicate a negative attitude). The attitude scores are put on a scale from -2 (strongly unfavorable) to +2 (strongly favorable). If a linear combination of a number of different issues is used as the position spectrum (e.g., via PCA, see Sec. 3.5), then the natural bias is the linear combination of the attitude scores for the different issues. It is important to remark that this method of placing group members on a position spectrum does not demand of the analyst the task of directly abstracting the range of policy options into a mathematical axis as do some spatial models of group decision making [3,18] — a task for which they may be ill-suited to perform. Rather, it asks for analyst assessments of the level of member agreement/disagreement on the more elemental and concrete aspects of the situation presented in the individual attitude statements.

The latitude of acceptance is calculated as the standard deviation of the natural biases obtained from the individual analysts. This makes the assumption that analyst differences with respect to the member's natural bias reflects genuine ambiguity or uncertainty in his position which in turn affects how open he is to different opinions. Other techniques are possible as well.

3.5 Structural Analysis

Independently of the ultimate simulation of the group interaction dynamics, the survey data can be analyzed to glean insight into the structure of the group of actors with respect to issues, the network of relationships, and actor power.

Structure of Issue Space: Actor positions on the attitude statements and issues can be investigated to understand relationships between different issues

and factional divisions among actors as defined by their positions on the issues. Matrix decomposition techniques such as Principal Component Analysis (PCA) can be used to investigate correlations between issues and actors and the effective dimensionality of the system [2]. PCA decomposes the matrix of actor attitudes on issues into orthogonal principal components. These principal components are ranked in descending order according to the variance of the data along each component. If the first principal component carries the bulk of the variance, then the system is effectively one dimensional. This would be the case, for instance, if one faction of actors consistently takes similar positions on distinct issues whereas another faction takes opposing positions on those issues. In such a situation, the differences between actors on a number of issues can be approximately reduced to a one-dimensional axis in accordance with the assumption of the nonlinear model. The position spectrum can be constructed in such a manner although interpretation is complicated by the fact that it is now a linear combination of a number of issues, rather than a single issue.

Network Structure: The network structure and actor roles as defined by the influence matrix can be analyzed using standard social network analysis methods. This is a distinct picture from that provided by the issue space structure although one would expect there to be similarities in the factional structures exhibited by both under the assumption that birds of a feather flock together, i.e., homophily. As with the issue space, PCA can be used to analyze and visualize the network [4]. If there is a strong factional breakdown in the network, this should be evident in the PCA visualization; those actors with a similar set of relationships should be found near each other in the visualization. For assessing individual roles and influence, metrics such as degree and betweenness centralities can be calculated. Weighted out and in-degree centralities reflect, respectively, the influence going out from and coming into the actor. These can be compared with the direct assessment of actor status from the survey; typically, the correlation between them is high. While the correlation between high status and high out-degree centrality would be expected for a leader, the correlation between high power and high in-degree centrality might be less expected. This stems from the larger number of actors that leaders are connected to and to whom they must be responsive if they seek to maintain the cohesion of the group; one would particularly expect leaders who are interested in consensus-building to have high in-degree.

Factional Maps: Actor issue positions, relationships, and power can be jointly visualized using a "factional map." The actor natural biases for the issue of concern are plotted on the horizontal axis, actor status on the vertical axis, and the relationships are plotted as links between the actors. Examples are shown in Fig. 3. The factional map provides an integrated representation of issue and network-based factional structure. Potential alliances can be identified as well as actors who could play key roles such as brokers or swing players. As an example, factional maps of Iraqi insurgent groups constructed directly from their rhetoric (rather than analyst judgments) reflected alliances that eventually

formed and showed the role of the Islamic Army in Iraq as a bridge between different ideological wings of the insurgency [10].

Another way of integrating ideologies and relationships is via the use of an ideology-weighted centrality metric. Here the tie strengths from the influence matrix are further weighted by a function that decreases with ideological distance, a gaussian for instance. This metric was used to analyze potential successors to Putin in 2007 [6].

3.6 Model Simulation

Model simulation is used to investigate potential results of the group decision-making process with respect to the policy outcome, the level of discord associated with that policy, and which group members sign on to the policy and which dissent. Group members are typically initialized at their natural biases and the model is run until equilibrium. (Currently, the time units are arbitrary given the difficulty of estimating the actual rates implicit in the commitment and coupling parameters.) The decision rule is used to aggregate the final member positions along the policy axis and the members of the winning coalition and dissenters are calculated. Sensitivity and scenario analyses can then be conducted to more fully assess the implications of the model.

The decision rule used to aggregate the group member final positions can be taken as the one chosen by the majority of analysts or it can be varied as well. For leader choice, the leader's final position is the policy. For weighted majority, the policy that has the most status-weighted support is the outcome; the support that each member provides to a prospective policy position decreases as a gaussian function of the distance between the prospective policy and his final position. This method allows for the policy outcome in a case of majority rule to reside within the range of positions of the majority. Otherwise, if a simple status-weighted linear combination of member positions were used then the chosen policy could lie somewhere between the majority and minority positions and, hence, would not correspond to majority rule at all. All those within their latitude of acceptance of the final policy are said to be in the winning coalition and those further away are deemed dissenters. The policy for a consensus decision rule is calculated in the same way as for a weighted majority but there can be no dissenters in order for the policy to be chosen.

Both sensitivity and scenario analysis involve varying parameters but their goals and the manner in which they are accomplished can differ. Sensitivity analysis involves running the simulation while sweeping over a parameter(s). This is used to judge the range of potential outcomes that can result due to uncertainty in model parameters. The selected parameter might be: (1) an intrinsically important one such as the coupling scale which is hard to pin down precisely and could significantly affect the results; or (2) one for which there is a large variance in analyst estimates indicating that there is substantial uncertainty in its value. The ability of an individual to sway the simulation outcome by changing his natural bias can be assessed using an "outcome centrality" metric

which can serve as a sensitivity analysis measure for addressing the importance of uncertainties in the preferences of individual group members [6].

Scenario analysis entails changing parameters to correspond with a hypothesized change in the situation, e.g., a particular member(s) dramatically shifts his position, a member's status increases, a member leaves the group or dies, or a tie between two members is severed. The scenario analysis can be run using natural bias initial conditions or from the equilibrium positions that resulted prior to the changes effected in the scenario.

4 Afghanistan Application

This section illustrates application of the methodology for the case of the ongoing conflict in Afghanistan. Both Afghan government elites and insurgent leaders were included as separate decision-making groups in the analyst survey. Analytical questions focused on the prospects of a negotiated solution between the two sides, continued U.S. presence and influence, the degree of centralization of the Afghan state, and ethnic tensions. Survey responses from analysts with expertise on Afghan politics and the insurgency were obtained in the spring of 2011. Analysis and simulation were conducted in Fall 2011. Some of the implications of this modeling exercise were incorporated into the analysis of Taliban strategy and Afghan government vulnerability presented in Ref. [12].

4.1 Elite Actors

The set of Afghan Government elite actors is listed in Table 1 and the Insurgent elite actors in Table 2. For actor selection purposes, an elite actor was considered to be an independently powerful individual who has communication with other members of his group and should have a power-base independent of his title or position. An actor's power base can be tribal, ethnic, regional, military, religious, or organizational in nature and the constituent members of the power base should hold more allegiance to the individual actor than to the elite actor group (Government or Insurgent) to which he belongs. For inclusion in the Afghan Government group, an elite had to (1) generally support the concept of an Afghanistan arranged along the lines of the current constitution; and (2) not use his influence or constituents to incite large-scale violence against Afghan government or Coalition forces. Insurgent elites had to be marked by the opposites of (1) and (2).

After the surveys were completed but prior to the analysis of results, two major events affected the composition of the actors in these groups: (1) Osama Bin Laden was killed by U.S. commandos in May 2011; (2) Burhanuddin Rabbani was killed in September 2011 by a suicide bomber posing as a Taliban peace emissary meeting with him in his capacity as chairman of the High Peace Council. The use of the Al Qaida core leadership as an actor rather than Bin Laden himself meant that the actor was not lost but his death clearly would be expected to have an impact on Al Qaida's status and relations with the other insurgent actors not

Table 1. Afghan government actors included in survey

Actor	Symbol	Ethnicity	Position
Hamid Karzai	KRZ	Pashtun	President
Mohammed Qasim Fahim	FHM	Tajik	Vice President
Karim Khalili	KAL	Hazara	Vice President
Burhanuddin Rabbani	RAB	Tajik	Chairman, High Peace Council; Head, Jamiat-e-Islami party
Abdul Rashid Dostum	DOS	Uzbek	Founder, Junbesh party; Armed Forces Chief of Staff (ceremonial)
Atta Mohammed Nur	NUR	Tajik	Governor, Balkh
Gul Agha Sherzai	SHZ	Pashtun	Governor, Nangarhar
Mohammed Mohaqiq	MOQ	Hazara	Head, Wahdat-e-Mardum party; Member of Parliament
Ismail Khan	IK	Tajik	Energy Minister
Abdul Rasul Sayyaf	SAY	Pashtun	Member of Parliament

Table 2. Afghan insurgent actors included in survey

Actor	Symbol	Organization	Role/Notes
Mullah Omar	MO	Afghan Taliban	Supreme Leader
Mullah Baradar	MB	Afghan Taliban	Former First Deputy (detained)
Mawlawi Abdul Kabir	AK	Afghan Taliban	Military Commander, Eastern Region
Haqqanis	HQN	Haqqani Network; Afghan Taliban	Amalgam of leaders Jaluluddin & Sirajuddin; also in Taliban Leadership Council
Gulbuddin Hekmatyar	HIG	Hezb-e-Islami	Leader
Al Qaida Leadership	AQ	Al Qaida	Amalgam of core leaders, e.g., Bin Laden, Zawahiri, Abu Yahya al-Libi

reflected in the original survey. However, simulations in which the corresponding parameters were reduced had little impact on the results. Rabbani's death meant the total loss of an actor. Simulations were conducted mostly with him removed from the data but the analysis helps reveal the potential motive behind his assassination as discussed in Sec. 4.4.

4.2 Survey Attitude Statements

The Ideology and Strategic Attitudes component of the survey contained 40 statements for the Insurgent side and 37 for the Government side. The statements explored a number of actor policy issues, ideological attitudes, and social identities such as insurgent political power, state centralization, U.S. influence, Pakistani influence, and Afghan vs. ethnic identities. Table 3 shows a selection of statements for Afghan Government actors bearing on the issues of state centralization and accommodation of insurgent political power.

4.3 Structural Analysis

Factional maps for both sides are displayed in Fig. 3. The policy issue concerns insurgent political power, which entails, on the Insurgent side, how much political

Table 3. Selected attitude statements for Afghan Government actors

1. Partition of Afghanistan should be considered to end the conflict, if necessary.
2. Afghanistan should have a federal system of government where regions have effective autonomy to govern themselves.
3. Karzai's efforts to concentrate power in the presidency show that the Afghan Constitution should be changed to institute a parliamentary-centered system of government.
4. A strong central government is needed in order to hold Afghanistan together.
5. The insurgents are criminals, terrorists and rebels who must be put down militarily, not negotiated with.
6. If the insurgents were to halt their armed struggle and disarm, they could legitimately represent their constituents as a political party.
7. It would be acceptable for the insurgents to openly join the political process without disarming if a permanent ceasefire is agreed to.
8. A coalition government with members including insurgent leaders would be the best way to represent the Afghan population and end the conflict.
9. The best way to achieve peace is to cede effective control of some parts of Afghanistan to the insurgents.

power they are striving for and on the Government side the degree of political power they should be accommodated. It is plotted on the same scale for both sides so that the Government actors mostly have negative scores indicating less accommodation of insurgent power and the Insurgents have positive scores (specific policy labels are noted in Sec. 4.4).

The Afghan Government map shows the non-Pashtun ethnic groups on the hawkish side of the spectrum and Pashtuns on the dovish side. Karzai is the most powerful actor and his network ties show him as a bridge between Pashtuns and non-Pashtuns. Importantly, Rabbani is seen to occupy a pivotal position as the least hawkish of the non-Pashtuns and having strong ties with Karzai and most of the other non-Pashtun actors. This indicates why Karzai may have selected him as chairman of the High Peace Council — to help bring non-Pashtuns onboard with the process of reconciliation with insurgents. For the Insurgents, Mullah Omar is the most powerful and is on the hawkish side of the spectrum. The other Taliban-affiliated actors are less hawkish. Al Qaida is seen to be on the extreme hawkish end of the spectrum but having the least status. Hekmatyar is on the dovish extreme of the spectrum but has relatively little power and has poor relationships with the other insurgent actors.

4.4 Simulations

Simulations of the nonlinear decision-making model of Eq. (4) are shown in Fig. 4 for the insurgent political power issue. The intervals along the position spectrum corresponding to different qualitative policies are indicated: "no power" — no insurgent political power is to be accommodated; "unarmed party" — insurgents can participate in politics after disarming; "coalition" — insurgent leaders should be brought into a national coalition government; "armed party" — insurgents can retain their arms, control some territory, and participate as a political party if they end their violence against the government; "central control" — insurgents seek to conquer the central state and control Afghanistan. The dashed lines which bracket the policies serve as rough guides rather than hard boundaries.

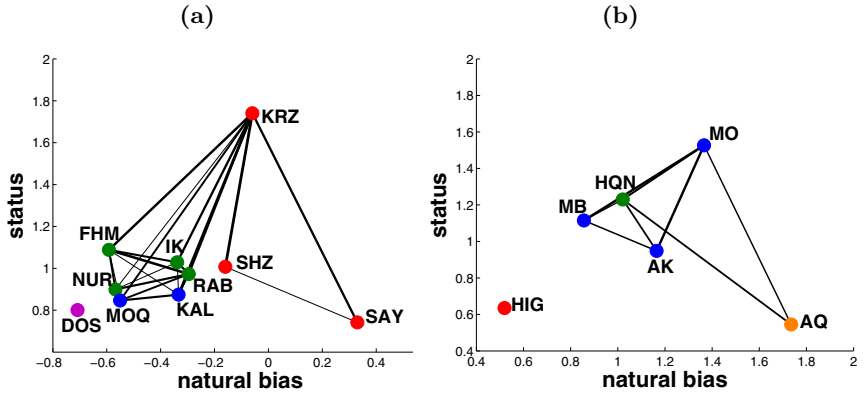

Fig. 3. Factional maps for insurgent political power issue. (a) Afghan Government actors, ethnicities — Pashtun (red), Tajik (green), Hazara (blue), Uzbek (purple). (b) Insurgent actors — those formally part of the Taliban organization in blue or green. Tie strength is proportional to link thickness; weak ties have been thresholded.

For the Afghan Government, the policy under a leader choice decision rule is seen to be "unarmed party," a policy which would support negotiations with insurgents and attempts to bring them into the political process. Dissenters include Nur, Mohaqiq, and Dostum on the hawkish side and Sayyaf on the dovish side. Note that although Rabbani is left out of the simulation shown in Fig. 4(a), none of the other model parameters were changed to account for the effects of his death, but scenario analyses aimed at doing so were conducted. For instance, to model hardened stances of anti-Taliban hawks in response to his killing, the above non-Pashtun dissenters had their commitments set to one, i.e., their positions are fixed, which has the effect of bringing Karzai to the "no power" policy interval. In addition, a sensitivity analysis shows that if the coupling scale were increased, due perhaps to an increased sense of threat to the government, then Karzai also would swing toward a more hardline policy closer to that favored by non-Pashtuns. In the immediate aftermath of Rabbani's assassination, Karzai did indeed become more hardline although since then he appears to have drifted back to a more dovish position, at least on a rhetorical level. In general, scenario analyses show that it is extremely difficult to forge a consensus policy on this issue and that if Karzai moves significantly to the left or right he will lose either Pashtun or non-Pashtun support respectively. This indicates his vulnerability to being isolated from one of these two key constituencies.

The Taliban are seen to coalesce around a "central control" policy which is Mullah Omar's choice. The only Insurgent dissenter is Hekmatyar who does not move significantly from his "armed party" natural bias given his weak links with the other actors. This solid support for a policy of seizing the central state indicates that Taliban negotiations overtures toward the United States in late 2011/early 2012 did not reflect a sincere desire to seek a peace deal with the Afghan government, as argued in Ref. [12]. In perhaps a confirmation of this conclusion, a recent article states that the U.S. government, previously hopeful,

has largely given up on negotiations with the Taliban [19]. Both sensitivity and scenario analyses indicate great difficulty in moving Mullah Omar from the "central control" policy to the "armed party" policy. For example, no matter how much Mullah Baradar were to move toward a dovish position (which might be a condition of his release), it would still not be sufficient to shift Mullah Omar into the "armed party" zone.

These simulations along with insight from the Afghan Government factional map suggest why the Taliban may have assassinated Rabbani and also their broader strategy toward the Afghan government [12]. The conclusion that the Taliban are dedicated to the goal of "central control" implies that they must pursue a military solution vis a vis the Afghan government rather than a negotiated one. Rabbani's pivotal position within the network of Afghan Government elites noted above suggests that his killing would serve to exacerbate ethnic tensions between Pashtun and non-Pashtun government elites and heighten the divide over how to deal with the Taliban; both through the loss of his direct influence as well as the shock of the act itself. This in turn would make it more difficult for Karzai to effectively act as a bridge between Pashtuns and non-Pashtuns as seen in Fig. 3(a) and increases his potential to be isolated from one of those groups. An isolated Karzai decreases the sense of national unity among Afghan government elites and the population at large. This weakened national unity and drop in cohesion within the Afghan government would in turn decrease support for the Afghan National Security Forces — the primary obstacle to a Taliban military victory given the planned U.S. force drawdown.

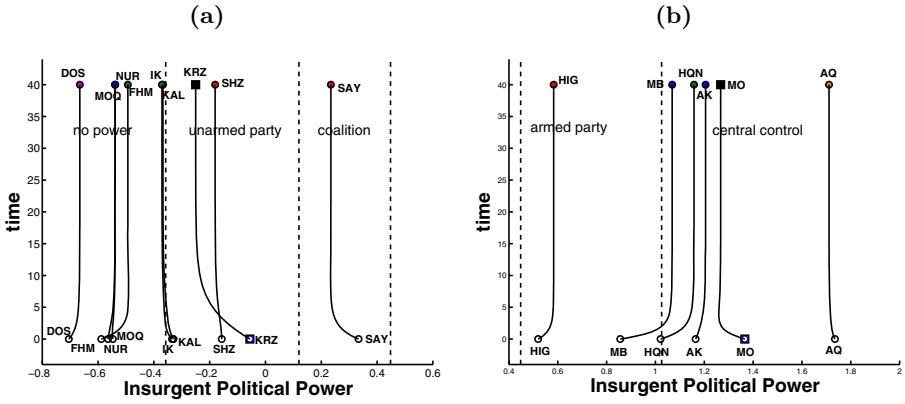

Fig. 4. Simulations of insurgent political power issue. (a) Afghan Government (w/o Rabbani), Karzai choice decision rule. (b) Insurgents, Mullah Omar choice decision rule. Open circles are actor initial positions, solid circles are final positions. Lines are actor position trajectories. Solid square indicates the final policy position; open square would be decision in absence of debate.

5 Conclusion

The nonlinear model employed to simulate decision-making outcomes synthesizes attitude change theory, social network structure, and nonlinear dynamical systems mathematics and so represents an innovative approach to the formal modeling of political decision making. The combination of the policy preference distribution in the group and its social network can form a complex structure whose complexity is further compounded by the nonlinear nature of the interactions between members in which member opinions need not move in simple proportion to their differences. The model provides a framework wherein these elements are integrated in a self-consistent manner that is not readily done by qualitative analysis alone, and allows for the controlled testing of the effects of changes or uncertainties in group variables. The nonlinear aspect of the model gives rise to the fact that the group dynamics can change *qualitatively* — and not merely as a matter of degree — as a function of the level of disagreement.

The associated analyst survey provides a systematic way of obtaining analyst judgment on the substantive aspects of the decision making group that enter into the model. The survey's use of attitude scale methodology to assess and calculate the ideological and policy positions of group members is natural given the nonlinear model's foundations in attitude change theory. This combination of attitude scaling and a formal model of elite decision making is another innovative aspect of the methodology outlined in this paper. It elicits analyst expertise on actor policy preferences without demanding that they perform the abstraction needed to create a policy axis or space itself, — a task which instead is left to the modeler.

As an alternative to implementation with analyst input, the use of rhetoric-based methods of obtaining actor ideologies and networks has been explored at the individual and organizational levels and used to inform policy analysis of ongoing situations [10,9,11,14]. A comparison of rhetoric-based Afghan Government and Insurgent actor ideologies with analyst assessments from the survey yielded good correlations for major issue dimensions. Other potential items for further research include: modeling multi-dimensional issue space dynamics; incorporating stochastic modeling and forecasting; a co-evolution model in which policy positions and actor relationships can evolve simultaneously; and integration with game-theoretic approaches.

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