Optimization-Based Influencing of Village Social Networks in a Counterinsurgency

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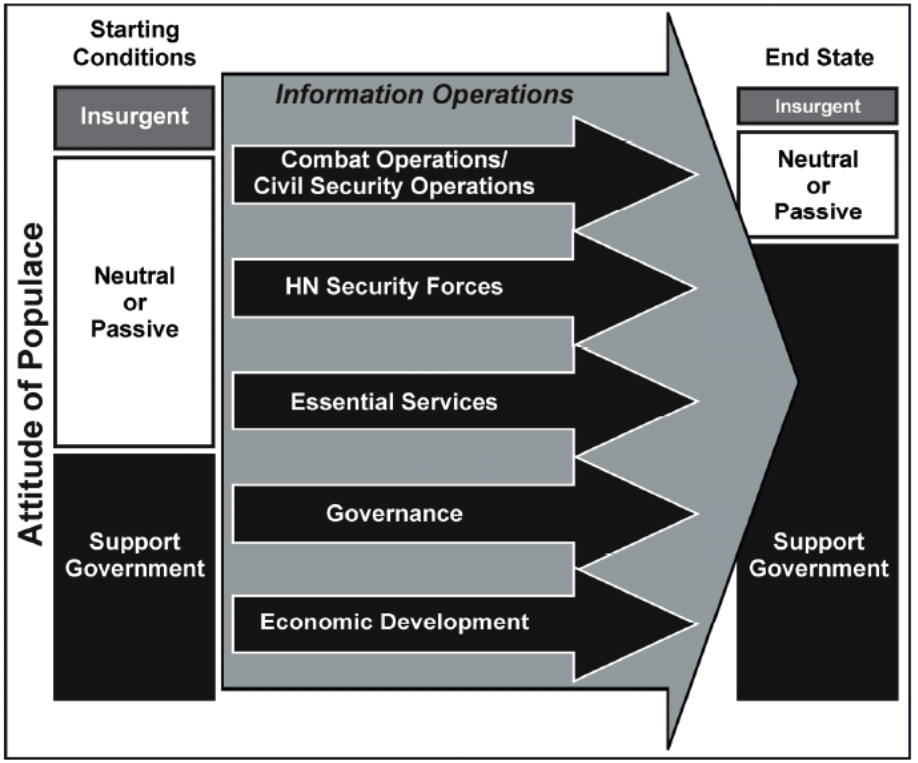
Popular Support in a Counterinsurgency

- All operations aimed to increase popular support of the government.
- Lines of effort help commanders identify missions, assign tasks, allocate resources, and assess operations.



* Host nation (HN)

Field Manual (FM) 3-24 *Counterinsurgency*, page 5-3, 5-6

Nonlethal Targeting Assignment Problem

The problem of deciding on the people whom US forces should engage through outreach, negotiations, meetings, and other interactions in order to ultimately win the support of the population.

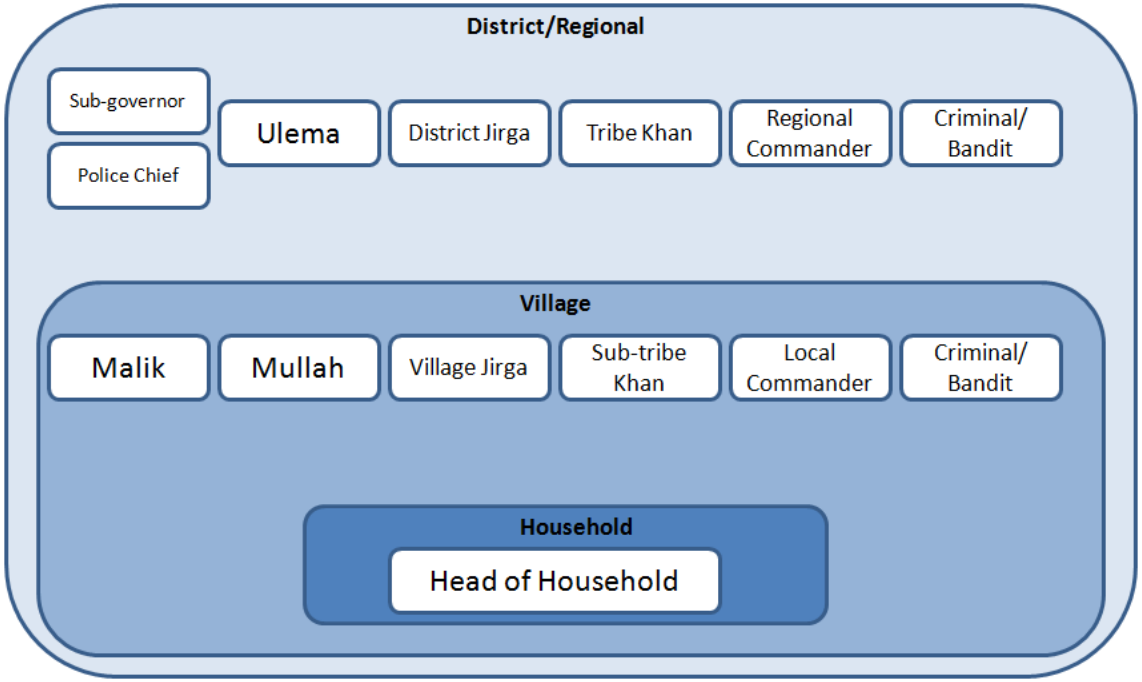
Our objective was to create a decision support tool at the *tactical* level in deciding nonlethal targeting assignments and predicting how population sentiments might change as a result of them.

Related Work

- **Opinion leadership** (social science concept of key individuals within groups). See Katz and Lazarsfeld [1955] and Weimann [1994].
- **Opinion dynamics** (explanatory models of how individual opinions may change over time). See Abelson [1964], DeGroot [1974], Friedkin & Johnsen [1999], Deffuant et al. [2000, 2002], and Hegselmann & Krause [2002].
- **Opinion dynamics with stubborn and influential agents**. See Acemoglu, et al. [2010].
- **Key person problem (KPP) literature** (quantitative methods to identify the *k*-best agents of diffusion of *binary* behaviors in a network). See Borgatti [2006] and Kempe, et al. [2003].

Study of Rural Pashtun Social Structure

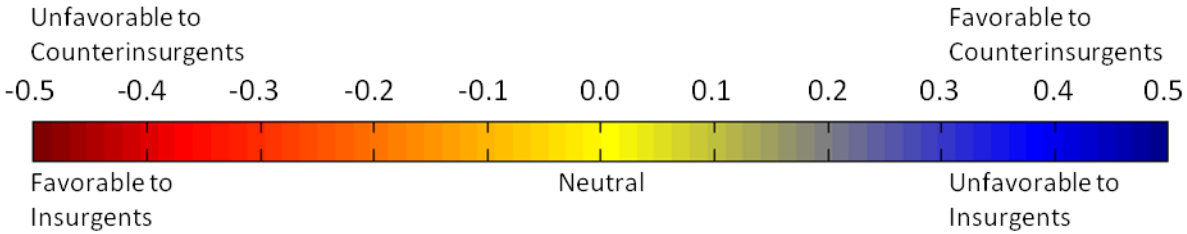
- Insular, remote, small villages.
- Communication in remote areas are still person-to-person[1].
- Traditional authority figures[2].
- Consensus-based decision making[3].



[1]See Wilson [2010]
[2]See Barth [1959],Rubin [1994], Afghanistan Research Reachback Center [2009], Oberson [2002] and Brick [2008]
[3]See Miakhel [2009], Brick [2008], and Glatzer [2002]

Afghan COIN Social Influence Model (1/2)

- Nodes/Agents:
  - Types: Local leaders, Taliban leaders, and US leaders.
  - Attitude: Random variable that takes on a scalar value at each agent interaction.
  - Taliban and US agents attitudes *do not* change.
  - Markov state: Vector of attitudes for all agents at a specific interaction



- Ties:
  - Represents a relationship supported by frequent person-to-person interaction, a channel through which influence occurs.
  - Influence along a tie is measured by the probability of a type of interaction that affects attitudes.

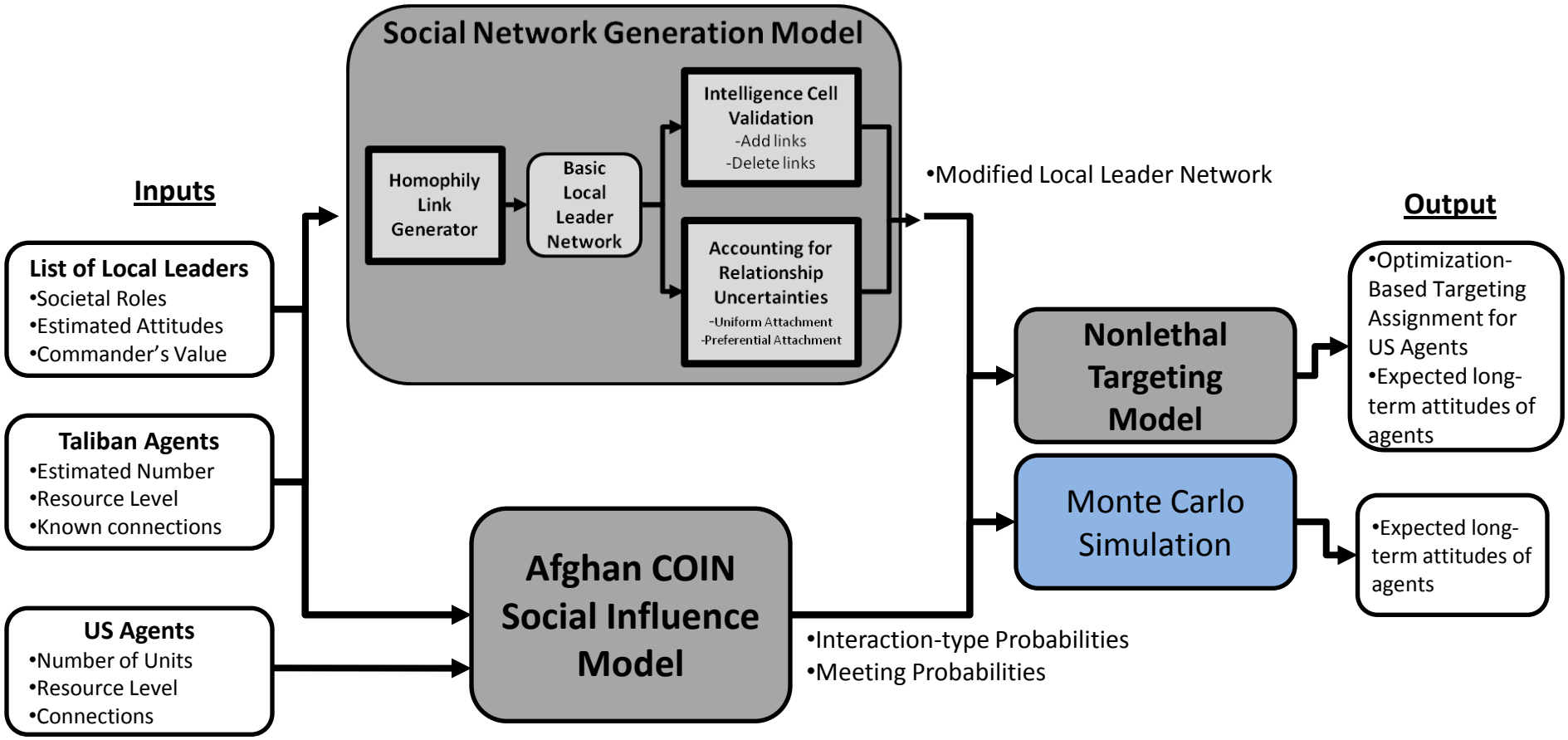
Afghan COIN Social Influence Model (2/2)

- Attitude dynamics in each interaction:
  - *Identity "no change"*, with some probability
  - *Averaging*, with some probability
  - *Forceful*, with some probability

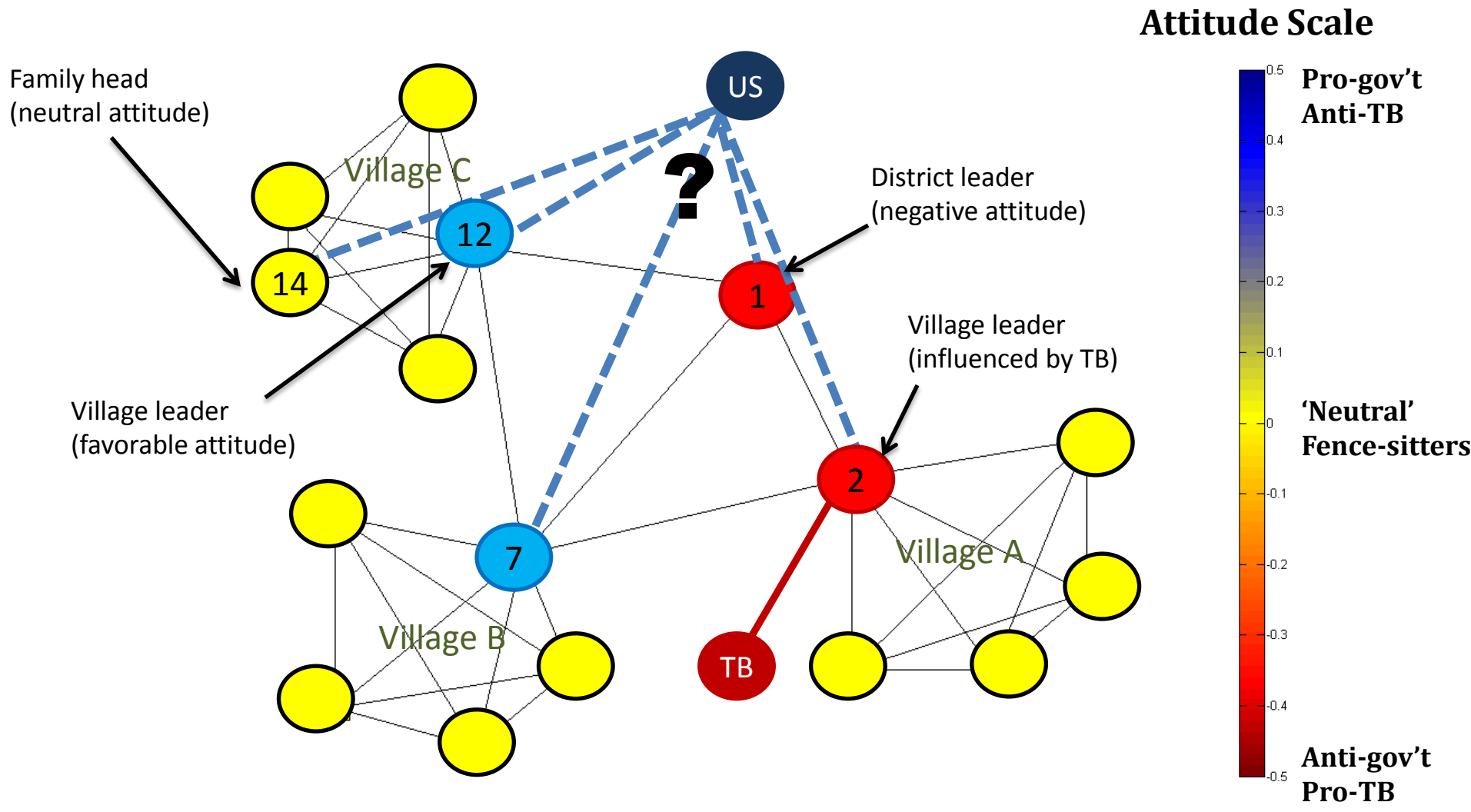
- Levels of 'forcefulness'

Level	**Position in Society**
Regular	Family heads (heads of household)
Forceful	Local or village leaders
Forceful $_1$	Regional or district leaders
Forceful $_2$	US forces, Taliban

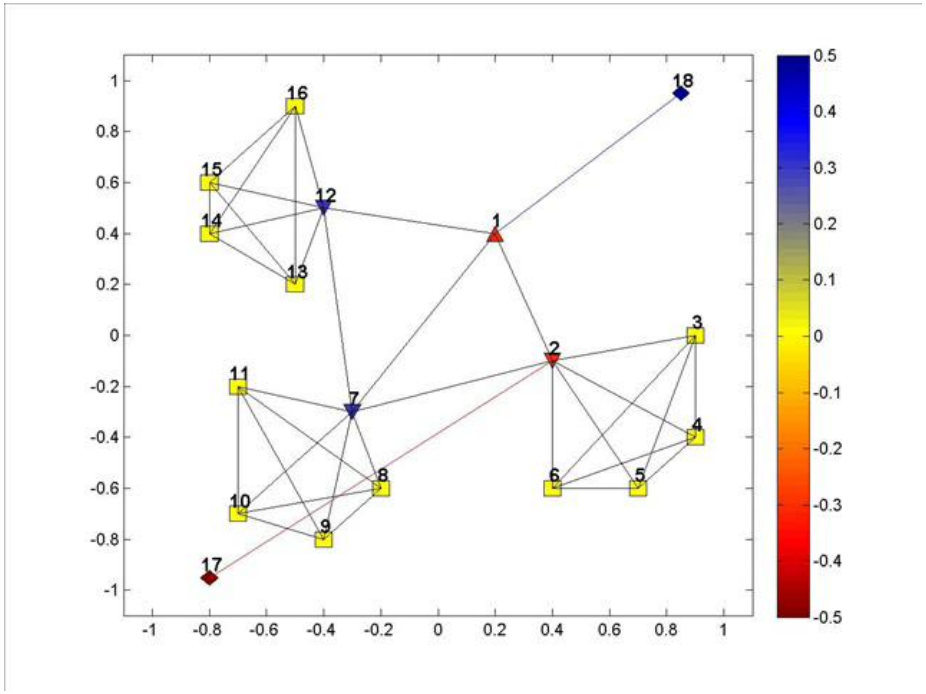
Overview of Models

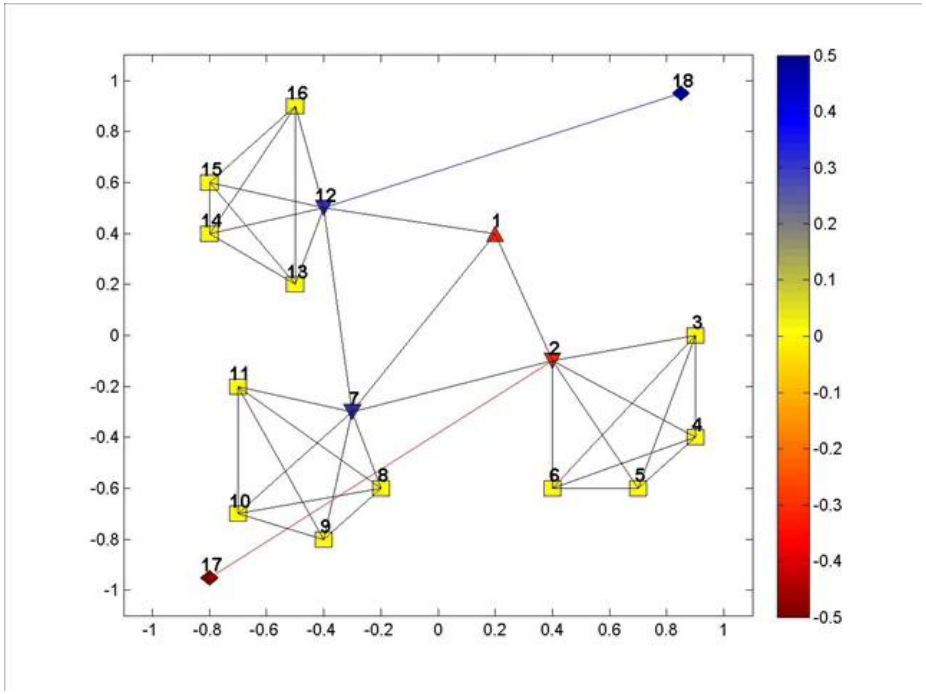


If the US tried to win over *one* person in network to improve attitudes, who should it be?



Interaction Simulation





Unfavorable to Counterinsurgents

Favorable to Counterinsurgents

-0.5 -0.4 -0.3 -0.2 -0.1 0.0 0.1 0.2 0.3 0.4 0.5

Favorable to Insurgents

Neutral

Unfavorable to Insurgents

Nonlethal Targeting Model

- Optimization-Based Target Selection.
- Objective: Maximize arithmetic mean of expected long-term attitudes of all agents.
- Binary decision variables: Assignment (connection) of *m* US agents to *k* non-US agents.

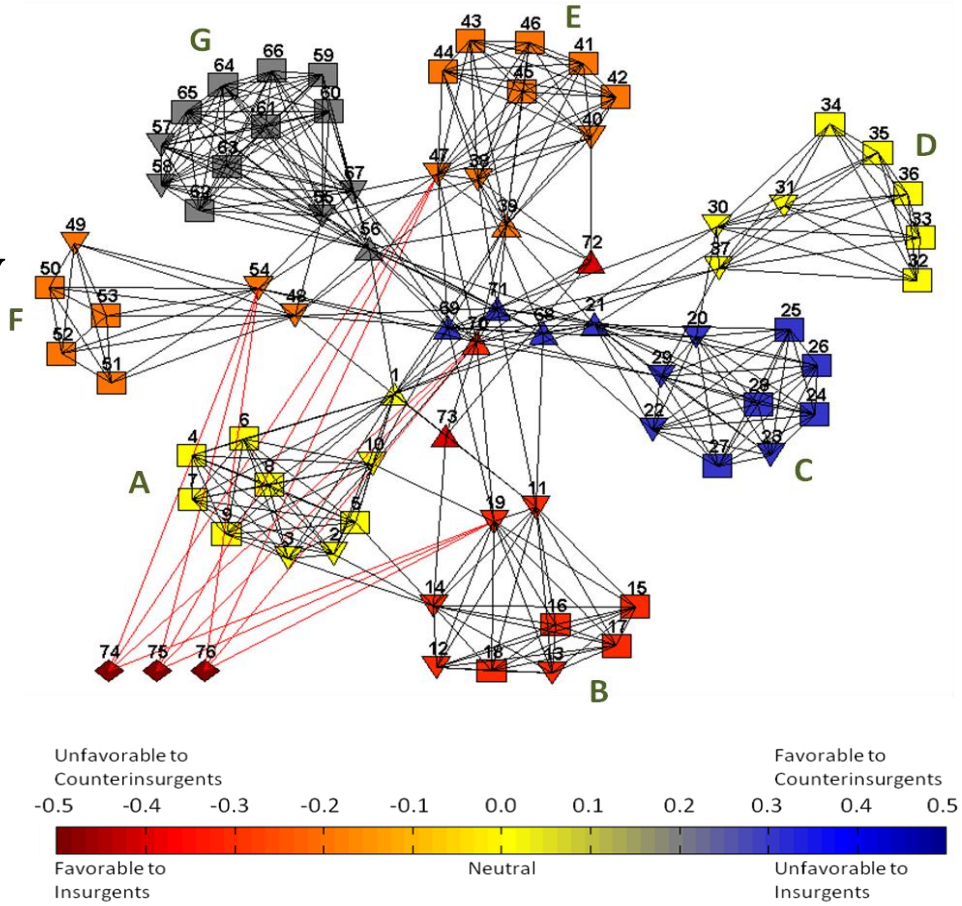
Doctrine-Based Assignment Strategy

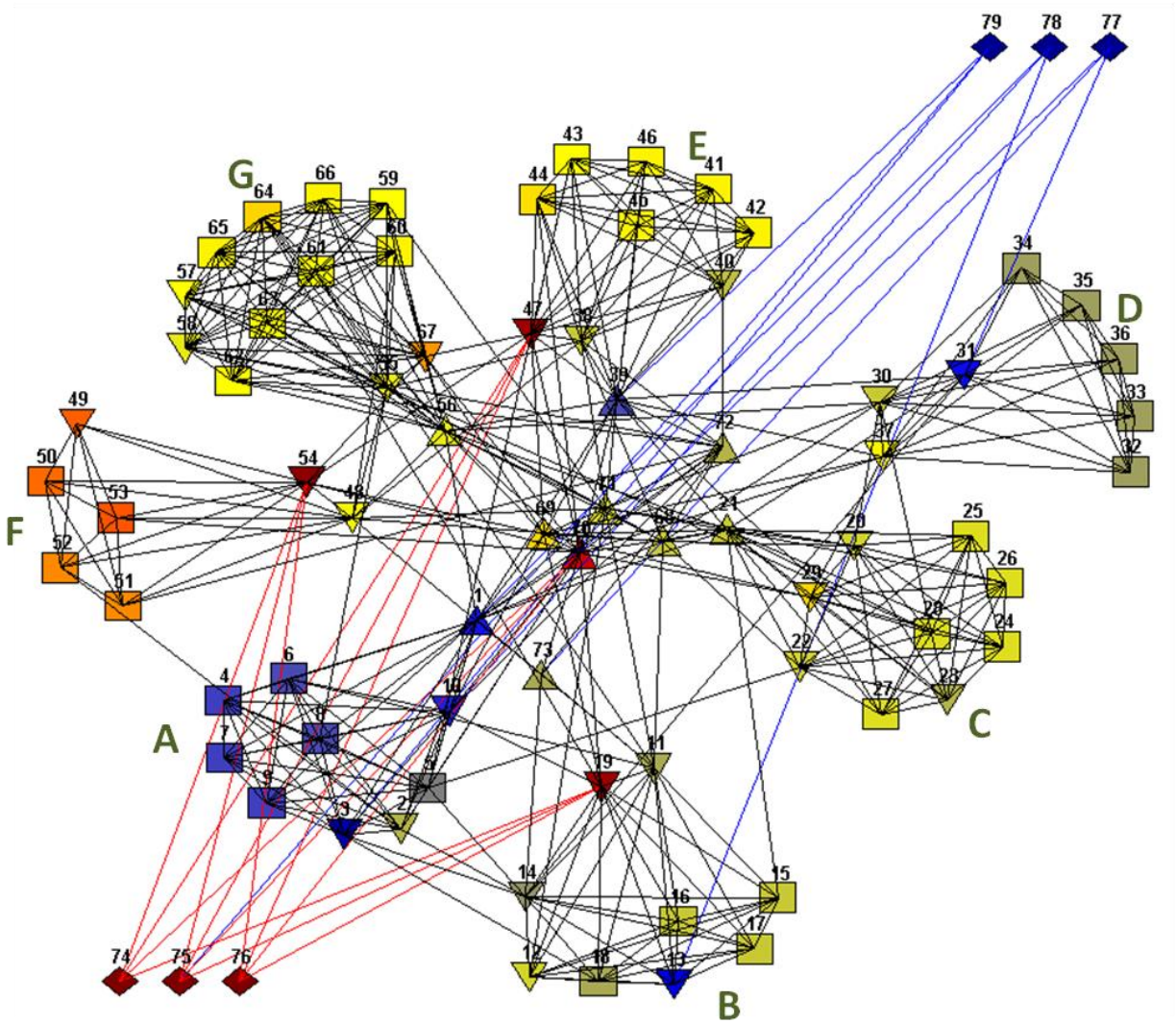
- "Identify leaders who influence the people at the local, regional, and national levels" (p. 5-9).
- "Win over 'passive or neutral people'" (p. 5-22).
- "[Nonlethal targets are] community leaders and those insurgents who should be engaged through outreach, negotiation, meetings, and other interaction" (p. 5-30).
- "Start easy…don't go straight for the main insurgent stronghold …or focus efforts on villages that support the insurgents. Instead, start from secure areas and work gradually outwards. Do this by extending your influence through the locals' own networks" (p. A-5).

Source: US Army Field Manual 3-24 (*Counterinsurgency*)

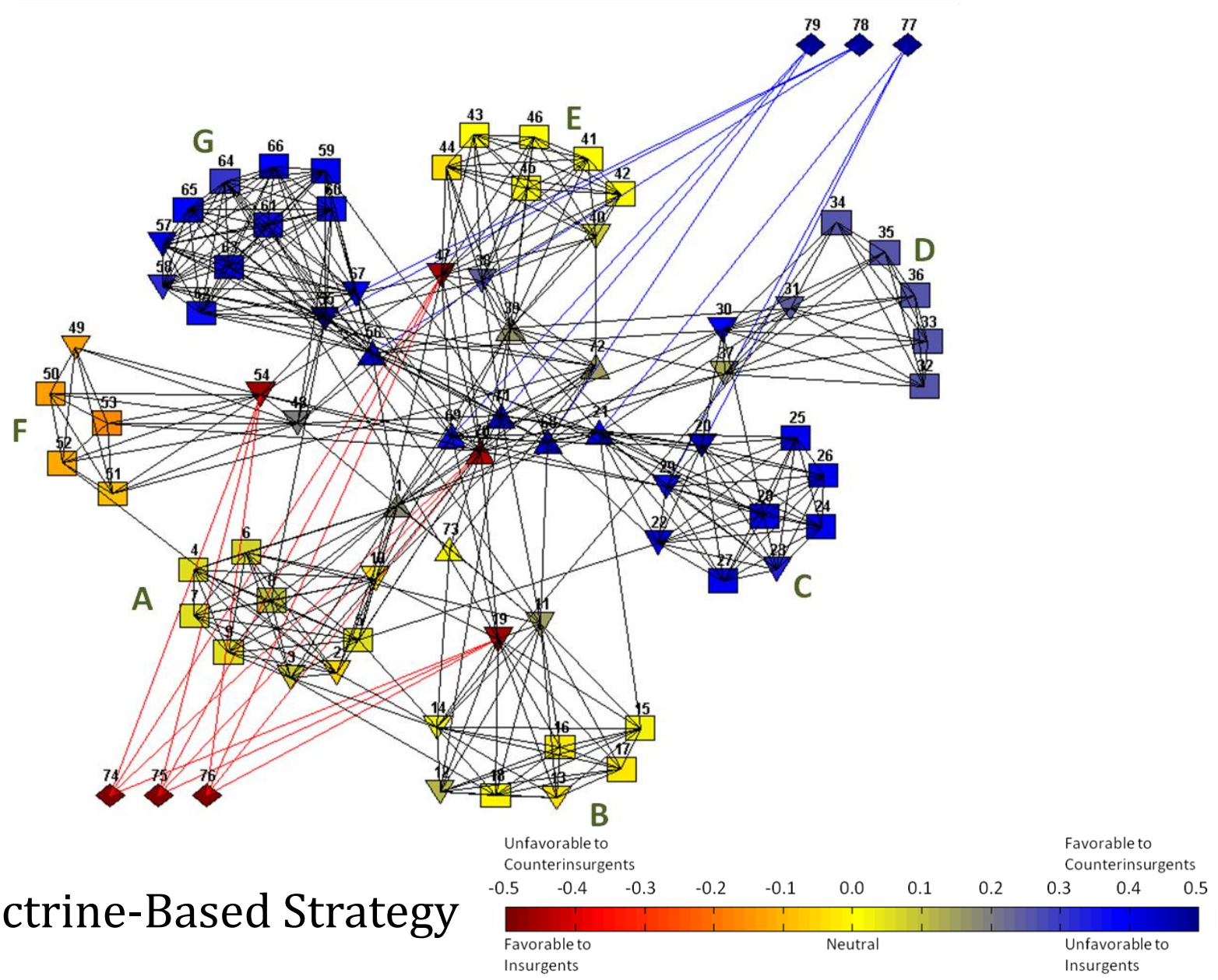
Experimental Results

- Optimization-based target selection performed significantly better than both random and doctrine-based target selection methods in analytic performance and in simulation.

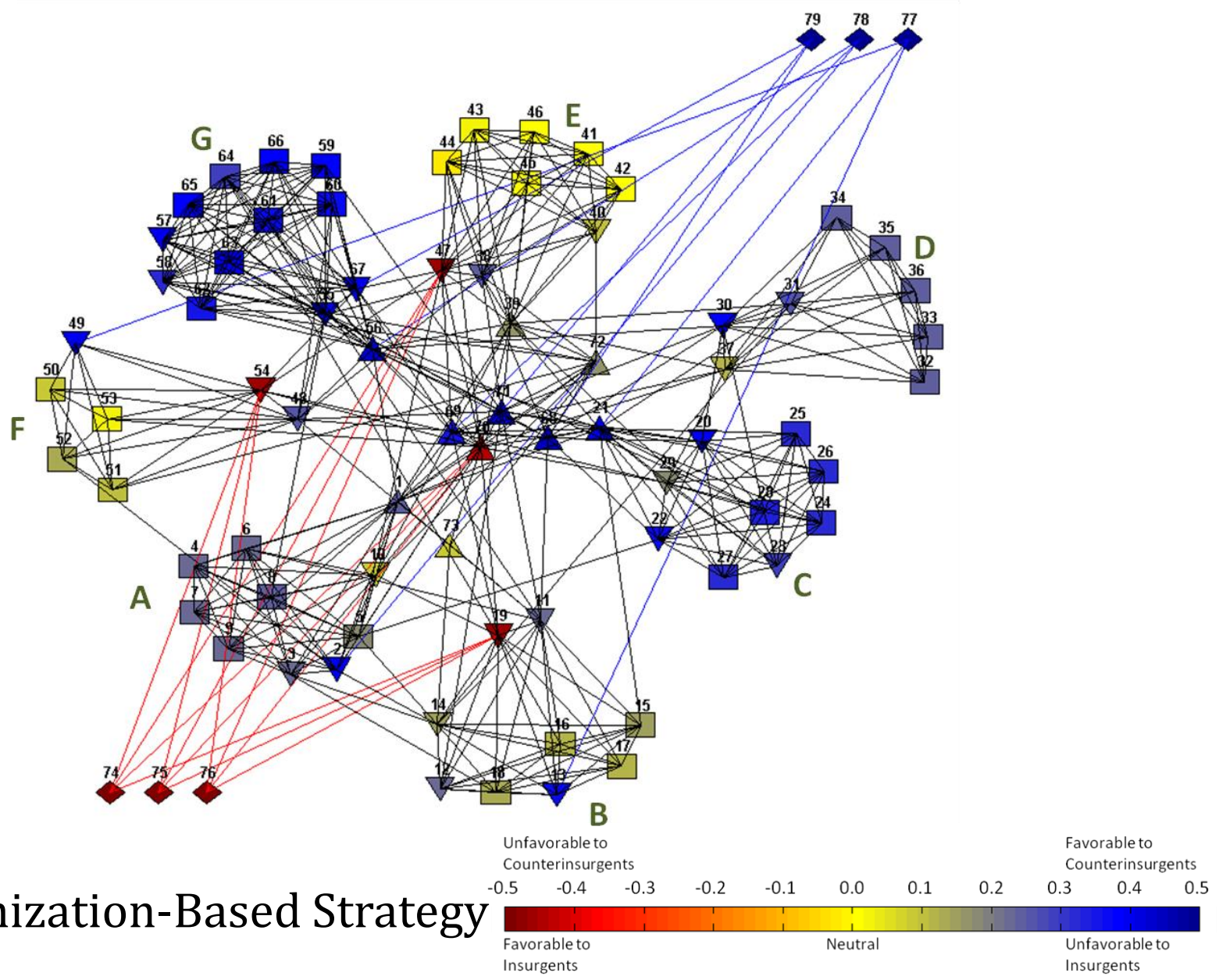




Random Strategy

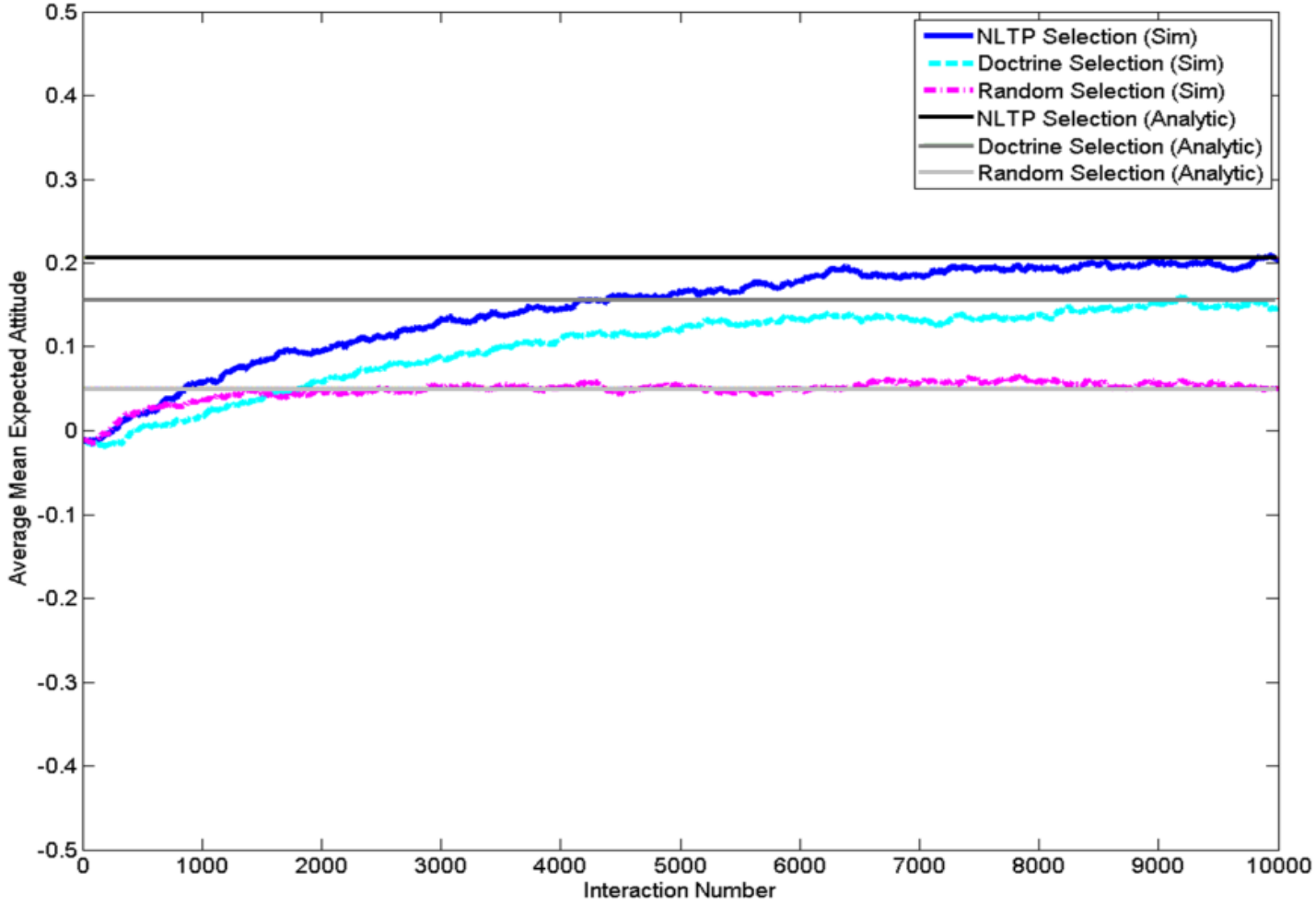


Doctrine-Based Strategy



Optimization-Based Strategy

Analytic and Monte Carlo Simulation Results



- Higher expected attitudes from NLTP assignment versus doctrine- or random-based assignment methods.

Overall Agent Selection Analysis

- In general, US was assigned to friendly forceful$_1$ local leaders.
- More interestingly, US was sometimes assigned to forceful$_0$ over <u>available</u> forceful$_1$ local leaders.

#	Times Selected	Agent #	Village	Societal Position	Forcefulness Level	Initial Attitude
1	7	21	C	District *Jirga* Member/*Khan*	forceful$_1$	0.3
2	7	49	F	Village *Jirga*	forceful$_0$	-0.2
3	7	69	-	District *Ulema*	forceful$_1$	0.3
4	6	56	G	District *Jirga* Member	forceful$_1$	0.2
5	6	68	-	District Police	forceful$_1$	0.3
6	6	71	-	Sub-governor	forceful$_1$	0.3
7	5	1	A	District *Jirga* Member	forceful$_1$	0.0
8	4	13	B	Village *Jirga*	forceful$_0$	-0.3
9	3	12	B	Village *Jirga*	forceful$_0$	-0.3
10	2	39	E	District *Jirga* Member	forceful$_1$	-0.2
11	2	67	G	Village *Mullah*	forceful$_0$	0.2
12	2	73	-	District Criminal	forceful$_1$	-0.4
13	1	2	A	Village *Jirga*	forceful$_0$	0.0
14	1	19	B	Village *Mullah*	forceful$_0$	-0.3
15	1	29	C	Village *Mullah*	forceful$_0$	0.3
16	1	37	D	Village *Mullah*	forceful$_0$	0.0
17	1	40	E	Village *Jirga*	forceful$_0$	-0.2
18	1	70	-	District *Ulema*	forceful$_1$	-0.3

Summary

- Current approaches to the nonlethal targeting assignment problem are qualitative and intuition-based.
- We propose a *tactical*-level decision support tool to select key persons to influence through nonlethal activities and to predict resultant population attitudes.
- The optimization-based assignment method achieves statistically significant greater population attitudes than doctrine or random-based methods.

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Questions?