What We Will Discuss

Why I am talking to you?
- Where I used to work
- What I used to do
- How I used to do it

Theories of terrorist organizations
- Sageman and Hoffman schools
- Empirical observations
- Who’s right?

Basic network analysis techniques used in CT
- Key actor analysis
- Detecting community structure
- Block modeling

Exploring with real networks
- Illicit drug network in Hartford, CT
- Covert terrorist network

Conclusions & Departing Thoughts
- New paradigms in network organization
- Using network analysis to address them
DISCLAIMER: All views and opinions expressed today are my own, and not those of U.S. Department of Defense or Office of the Director of National Intelligence

Currently, a fourth year PhD student in Politics, research interests include...

- Terrorism, low-intensity conflict, and cyber warfare
- Agent-based modeling, machine learning, and network analysis

Prior to entering graduate school...

- Worked in DC in the defense and intelligence communities for four years
- Official title was “All-source analyst,” specific role was to apply statistical and computational methods to problems of social dynamics and organization of interest to the DoD/IC.

**NO**: If I tell what I *really did* I will not have to kill you...they never have the analysts do the killing
Organization of the IC & Where I Worked

Defense Intelligence Agency
- "Getting intelligence to the war fighter"
- SIGINT and cryptology

National Security Agency
- SIGINT and cryptology

Central Intelligence Agency

United States of America

NATIONAL COUNTERTERRORISM CENTER
Integrates and analyzes all intelligence pertaining to terrorism and counterterrorism. Conducts strategic operational planning by integrating all elements of national power. Sixteen intelligence communities stem from the NCTC wheel.

Drew Conway

Analyzing Terrorist Networks - Theories & Techniques
### The Sageman and Hoffman Schools on Terrorist Organizations

**Sageman School**
- Marc Sageman - former CIA case officer for Islamabad
- Currently Scholar in Residence at the NYPD

Terrorist groups are independent, or loosely connected cells
- Organization driven by a group process; result of circumstance, motivation and opportunity
- The types of social ties are extremely important: **kinship, friendship and religious**

*From Leaderless Jihad...*

“...the links are very interesting because it turned out that 68% joined the Jihad out of friendship, they either grew up with somebody who was already a terrorist, or there was a bunch of guys who collectively decided to join.”

**Hoffman School**
- Bruce Hoffman - History professor at Georgetown University
- Respected academic in terrorism studies, published widely read *Inside Terrorism*

Terrorist groups are hierarchical structures
- Global terrorist organization are well-formed and lethal
- Critical information and resources flow down from the leadership to low-level operatives

*From Foreign Affairs*

“...Al Qaeda is much like a shark, which must keep moving forward, no matter how slowly or incrementally, or die. Al Qaeda must constantly adapt and adjust to its enemies’ efforts to stymie its plans while simultaneously identifying new targets.”
Evidence in support of Sageman

The “Hamburg Cell”

- Late 1998, future 9/11 hijackers Mohammed Atta, Marwan al-Shehhi, and Ramzi Binalshibh moved into a three-bedroom apartment
- Originally intending to fight jihad in Chechnya, a chance meeting on a train in Germany caused the group to travel to Afghanistan instead.

Several more contemporary examples

- 2004 Madrid Train Bombing – “al-Qaeda inspired cell”
- July 7, 2005 London bombings – 4 British, 3 Pakistani and 1 Jamaican motivated by British involvement in Iraq War
- Alexandria 5 – N. VA students travel to Pakistan to join Taliban

Excerpt from “The Pact”

“This is a story about the power of friendship. Of joining forces and beating the odds...”
Evidence in Support of Hoffman

2002 Bali Bombings
- Coordinated attack carried out by Jemaah Islamiyah (JI), Southeast Asian militant Islamic group
- Deadliest attack in Indonesia’s history, killed 202 people
- Organized as a hierarchy, though many leaders have since been killed or captured

International terrorist organizations remain lethal
- 2008 Mumbai attacks – 10 coordinated attacks perpetrated by Lashkar-e-Taiba militants from Pakistan
- Beslan school hostage crisis – Chechan militants seize school with 1,100 people (including 777 children) for three days. Ultimately, 334 hostages were killed, including 186 children.
- Richard Reid (shoe bomber) – admitted member of al-Qaeda

2007 NIE The Terrorist Threat to the US Homeland

“Al-Qaida is and will remain the most serious terrorist threat to the Homeland, as its central leadership continues to plan high-impact plots, while pushing others in extremist Sunni communities to mimic its efforts and to supplement its capabilities.”
Sorting out the debate

Who’s right?
**Spoiler:** Both men are correct, and wrong

Karen J. Greenberg, Executive Director of NYU Center on Law and Security

“Sometimes it seems like this entire field is stepping into a boys-with-toys conversation. Here are two guys, both of them respected, saying that there is only one truth and only one occupant of the sandbox. That’s ridiculous. Both of them are valuable.”

- Since 9/11, the persistent, coordinated and international effort to kill or capture terrorist leaders has decimated the structure of transnational terrorist organization
- For those left, movement, communication and planning has become incredibly strained

Enter the age of the “al-Qaeda Affiliates”
- Model has moved away from strictly hierarchical or cellular to a franchise
- Leadership provide inspiration, rather than resources and ideas
- Umar Farouk Abdulmutallab and the al-Qaeda in the Arabian Peninsula
Why study networks for CT?

9/11 Commission Report - Chapter 12

“Our enemy is twofold: al Qaeda, a stateless network of terrorists that struck us on 9/11; and a radical ideological movement in the Islamic world, inspired in part by al Qaeda, which has spawned terrorist groups and violence across the globe. The first enemy is weakened, but continues to pose a grave threat. The second enemy is gathering, and will menace Americans and American interests long after Usama Bin Ladin and his cohorts are killed or captured. Thus our strategy must match our means to two ends: dismantling the al Qaeda network and prevailing in the longer term over the ideology that gives rise to Islamist terrorism.”

After 9/11, the IC becomes focused on understanding networked organizations, with a specific focus on dismantling and disrupting
Primary focus is one three aspects of network analysis

1. Identifying leadership and key actors
2. Revealing underlying structure and intra-network community structure
3. Evolution and decay of social networks

We will review 1-2; however, 3 is where most cutting edge network research is focused
Often social network analysis is used to identify key actors within a social group. To identify these actors, various centrality metrics can be computed based on a network’s structure:

- **Degree** (number of connections)
- **Betweenness** (number of shortest paths an actor is on)
- **Closeness** (relative distance to all other actors)
- **Eigenvector centrality** (leading eigenvector of sociomatrix)

One method for using these metrics to identify key actors is to plot actors’ scores for Eigenvector centrality versus Betweenness. Theoretically, these metrics should be approximately linear; therefore, any non-linear outliers will be of note.

- An actor with very high betweenness but low EC may be a critical **gatekeeper to a central actor**
- Likewise, an actor with low betweenness but high EC may have **unique access to central actors**
Highlighting Key Actors

Using data collected on a network of drug users in Hartford, CT we will attempt to identify the identity and location of the key actors.

First, visualize the data

1. Clear bifurcation within the network
2. Each region of the network appears to cluster around central communities
3. Sparse peripheral structure with long “pendant chains”

Given these structural features we will want to identify actors both inside the network’s core, but also those with unique structural positions.
Finding Key Actors with R

- Perform a linear regression of $Eig \sim Bet$
- Capture residuals from regression
- Use this data to resize and color the actors in the plot
- Identify key actors:
  - Pulse takers
  - Gate-keepers

Actor 44 is a significant outlier, and likely part of the central leadership, while actors 50, 28 and 53 are pulse takers and 67, 102, and 79 are gate-keepers.

...now add this visualizations together
Introduction

Theories of terrorist organizations

Network Analysis and CT

Conclusions

Key Actor Plot

Plot with key actor data

Good

- Very easily identify core leadership
- Mid-level actors, pulse-takers, layer
- Highlight some bridges, gate-keepers

Bad

- Several key actors not highlighted
- Over-emphasis on one community due to data asymmetry
Identifying Network Sub-Structure

The Hoffman School posits that terrorist networks will contain layers of connectivity and leadership.

To identify these layers, we will examine an actual covert network.

- Covert networks often exhibit a “core-periphery” structure
- We may want to identify clusters of actors based on various structural features
Methods for Community Detection

Identifying community structure within a network is an entire sub-discipline of network science.

- Google Scholar search for [“community detection” networks] returns 3,380 articles since 2001
- There is an incredible diversity of methods
  - Statistical
  - Spectral
  - Node and edge context and/or attributes

We will be using a very basic method from the statistical category: hierarchical clustering of geodesic distance

- Clusters nodes together based on their distance (closer nodes clustered together)
- Returns several possible partitions
- Method is both art and science
Hierarchical Clustering of Geodesic Distance

First, we will generate a matrix of the distance between all node pairs. Clustering this data hierarchically, we can produce a dendrogram of all the community cuts within our covert network.

- Each break in the tree represents a cut in the community structure.
- Further down the tree, the more granular the communities.
- To find a “good” set of community partitions we can step through them visually.
Stepping through the partitions

We will now visualize each community cut.
Partition: 123456789
To reveal the underlying structure of these communities, we will collapse these communities into single nodes using a technique known as “block modeling”

Suppose we wanted to view partition 8 as a block model

We can also take advantage of additional data generated by the block model:

- Each block represents some number of nodes with ties to each other, as well as actors in other blocks
- We can use that data to uncover both the underlying structure, as well as the tie dynamics within and among blocks in the model
- This is best revealed by combining this data into a visualization

In the block model, each colored group will become a single node
Block Model of Partition 8

With the added data we can alter the visualization:

- Blocks sized by internal density
- Edges sized by tie strength

We can now see some distinct underlying structural dynamics:

- Ignore block 8
- Central leadership very tightly connected
- Middle layer sparsely, but strongly connected
Developing New Theories of Terrorist Organizations

What is the influence of information technology on terrorism and terrorist organizations?

- Cyber-terrorism blurs the lines among transnational terrorism, state-sponsored attacks, rogue actors and homegrown threats
  - Is it possible to distinguish among these threat?
  - Is attribution possibly in cyber?
- The barriers to influence approach zero through the Internet
  - Recruitment still primarily through in-person connections, but significant push to online

How does the franchise model change theories of organization?

- With the vanishing operational importance of terrorist leadership, how can resources be maximized for CT?
- Is there more value in disrupting communication networks (e.g., inspiration/influence) than operation (e.g., franchise cells)?

Can network analysis mitigate these new problems?
subsections new theories (end)
Thank you!

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