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Using Survey Data to (Help) Parameterize Human Terrain Models

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Using Survey Data to (Help) Parameterize Human Terrain Models

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Agenda

To provide an overview of the techniques used to facilitate data development for models of the civil population.

• Problem
• Overview of Cultural Geography (CG) model
• Narrative identity paradigm
• Factor analysis of survey data
• Using factors to model reactions to events
• Questions and discussion
The Problem

Irregular Warfare is a violent struggle between state and non-state actors for the control of the relevant population
   – The U.S. Army/Marine corps counterinsurgency field manual

• Context:
  • Modern warfare necessitates an understanding of civilian populations (the “human terrain”)
  • Part of this involves models that provide insight into how human terrain may react to events

• Problem:
  • Developing data for models using qualitative analysis is expensive and time consuming
Cultural Geography Model

Conflict Ecosystem

1. Civilian Populace
   - Social Network
     - Tribal/Political
     - Homophily
     - Education
     - Trust
     - Age

2. Other Actors
   - Insurgents
   - Other: HNSF, CF

3. Infrastructure
   - Structural
   - Commodities: Markets, Services

4. Events
   - Events cause updates to issue stance

Influencing Groups

1a. Population Stereotypes
   - Demography: Age, Tribe, Politics, Education

1b. Human Cognition
   - Values
   - Interest
   - Beliefs

Theory of Planned Behavior

Other Actors

1c. Influence
   - Education
   - Trust

Entity Stereotype

Atacks

Values

Narrative Identity

Issue Stance
“Narratives are the means through which ideologies are expressed and absorbed by members of a society.”

COUNTERINSURGENCY (FM 3-24/ MCWP 3-33.5)

• The narrative identity paradigm, developed by Walter R. Fisher, claims that people are essentially story tellers
  – A descriptive theory of behavior that connects individual beliefs and activities to cultural factors

• Individuals and groups in the Cultural Geography model attempt to maintain a degree of narrative rationality in their beliefs and attitudes

• Agent Stereotypes and the Belief Networks in the CG model are instantiations of the Narrative Identity
Issues & Belief Nets

- Determine issues through doctrine, command guidance, analysis of population
- Conceptually determine the beliefs, values and interests that influence the population on the issue
- CG model currently uses Bayesian networks

### Legitimacy of the Iraqi Security Forces

<table>
<thead>
<tr>
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<th>Illegitimate</th>
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<tbody>
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### Legitimacy of the Government of Iraq

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<td>50.3</td>
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### Perception of the Level of Violence

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### Perception of Coalition Forces

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### Issue 1: Is security in Amarah adequate?

<table>
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<th>Inadequate</th>
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<td>86.1</td>
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Parameterizing the Belief Nets

• One approach: expert elicitation
  – How will a demographic stereotype with given belief react to a particular event?

• 10-20 beliefs x 80-100 demographic stereotypes x 10-20 events = 8,000-40,000 elicitation!

• Takes an expert 30-60 hours to do them all
  – Data fatigue?
Alternate Approach: Using Surveys

• Population stereotypes (1a):
  – Survey demographics can provide insight into population sizes of relevant stereotypes

• Narrative identity (1b):
  – Using (existing) survey data, derive beliefs from responses to questions
  – Use derived beliefs in statistical models to link demographics and beliefs to events
Factor Analysis

• Factor analysis models the covariance of observed variables as linear combinations of unobserved (latent) variables
  • Factors should achieve both “statistical simplicity and scientific meaningfulness” (Harmon, 1976)

• For survey data, utility is to “determine what sets of items hang together in a questionnaire” (DeCoster, 1998)
Factor Analysis Example

Q7: How much trust do you have in your local police?

Q17: How safe do you feel here in [CITY/TOWN/VILLAGE]?

Q19: How would you rate the level of violence in your community?

Q25: How much do you think [COUNTRY] helps to prevent terrorist attacks?

Security

- Q7: 0.58
- Q17: 0.61
- Q19: 0.64
- Q25: 0.67
Using Factors in Models

• If appropriate factors emerge from survey data, can model how “issue stances” change with beliefs (factors) and demographics:

\[ Y = f\left( F_1, \ldots, F_n, D_1, \ldots, D_m \right) \]

• Given factors are linear combinations, could be as simple as a multiple regression model

• Logistic and ordinal logistic models may be relevant too, depending on how issue stance measured
Issues with Factor Analysis

• Fielding survey(s) purely for this purpose may be monetarily infeasible

• Question responses must have sufficient variance
  • Those with uniform responses will not load onto factors

• The narrative paradigm tells us that individuals with similar narratives should have similar responses
  • Hence, there are limits to how far can “drill down” into survey data with factor analysis modeling
  • Factor analysis can still be used on the population as a whole
Summary

• Population data can be expensive and time consuming to develop
• Survey data contains much of the necessary information
• Factor analysis provides a means to access this information
• Data specific to demographic groups can be developed using regression
Questions?