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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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July 25, 2012

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

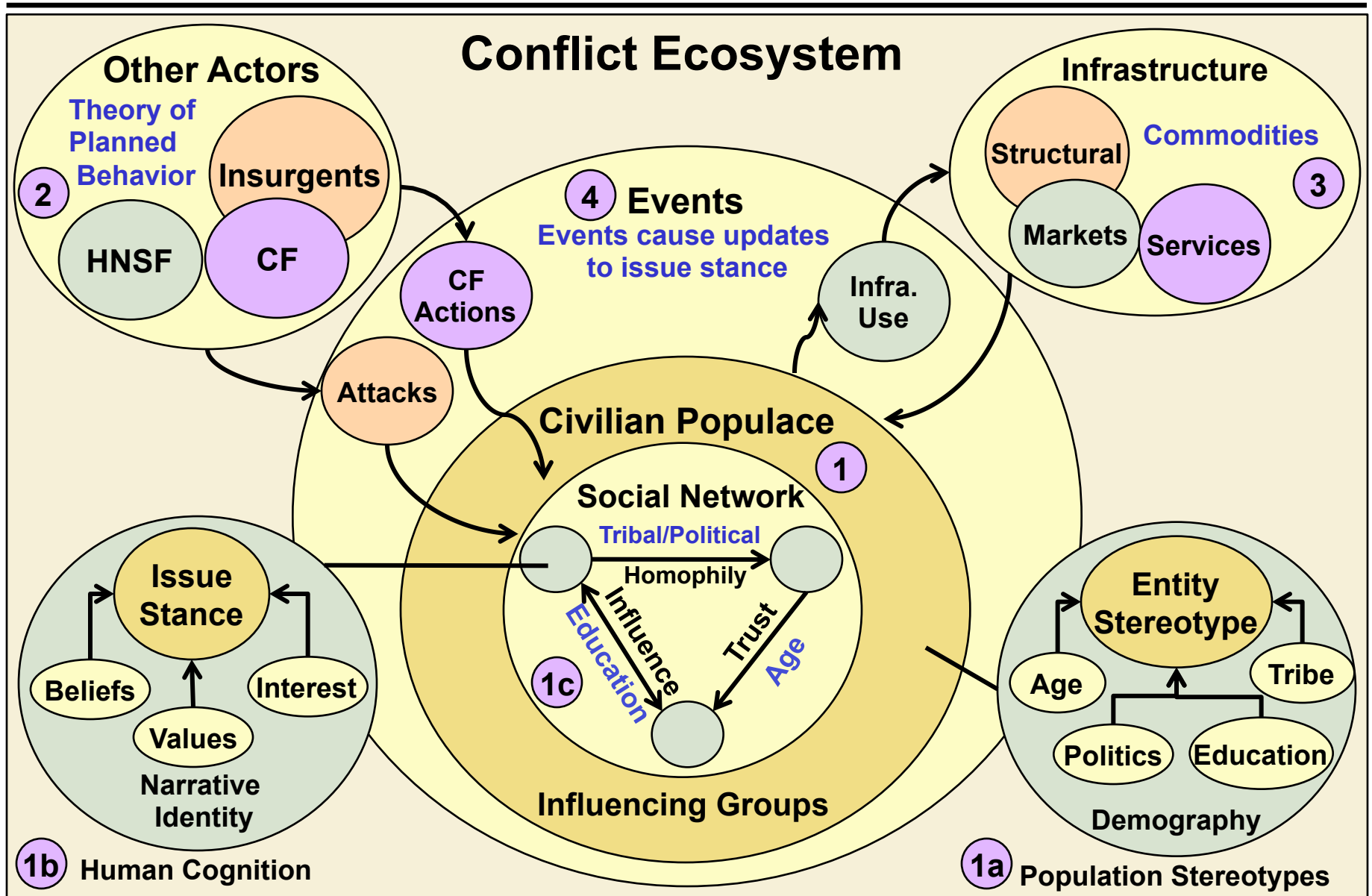
The Problem

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



Narrative Identity

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

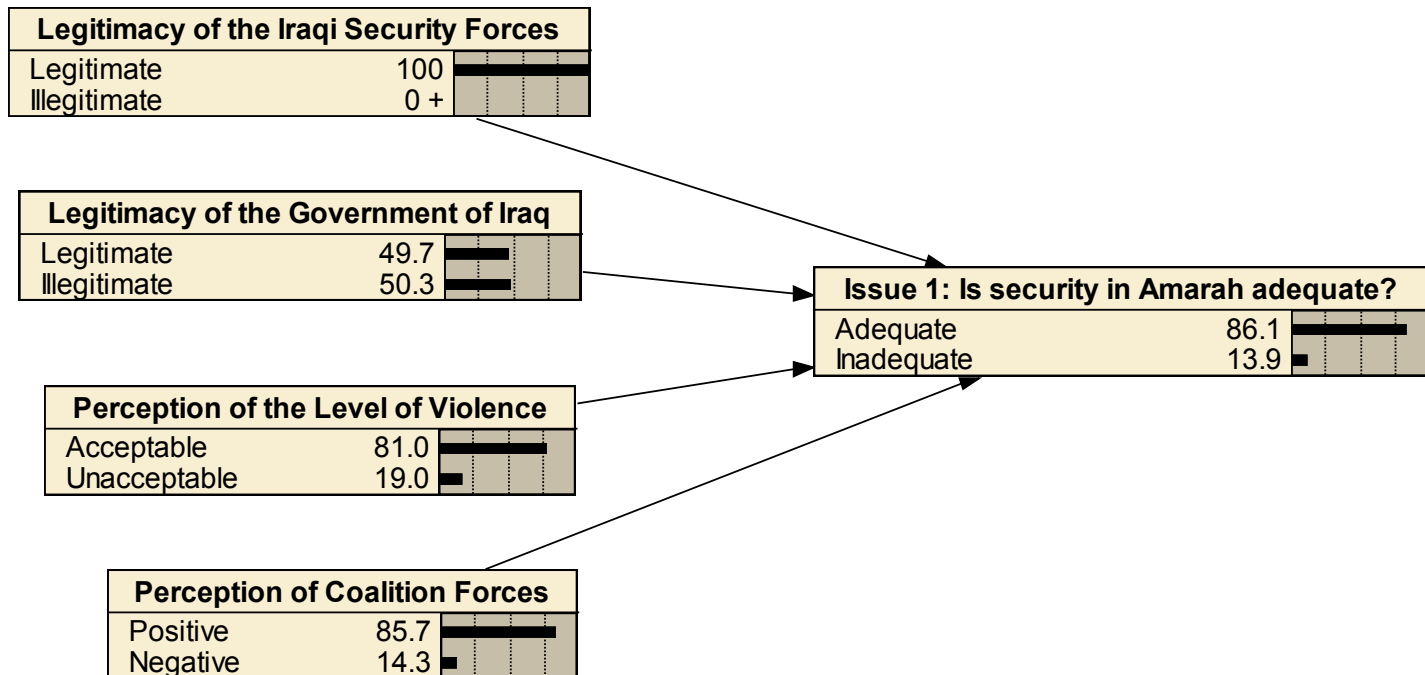
COUNTERINSURGENCY (FM 3-24/ MCWP 3-33.5)

- 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



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 elicitations!
- Takes an expert 30-60 hours to do them all
 - Data fatigue?

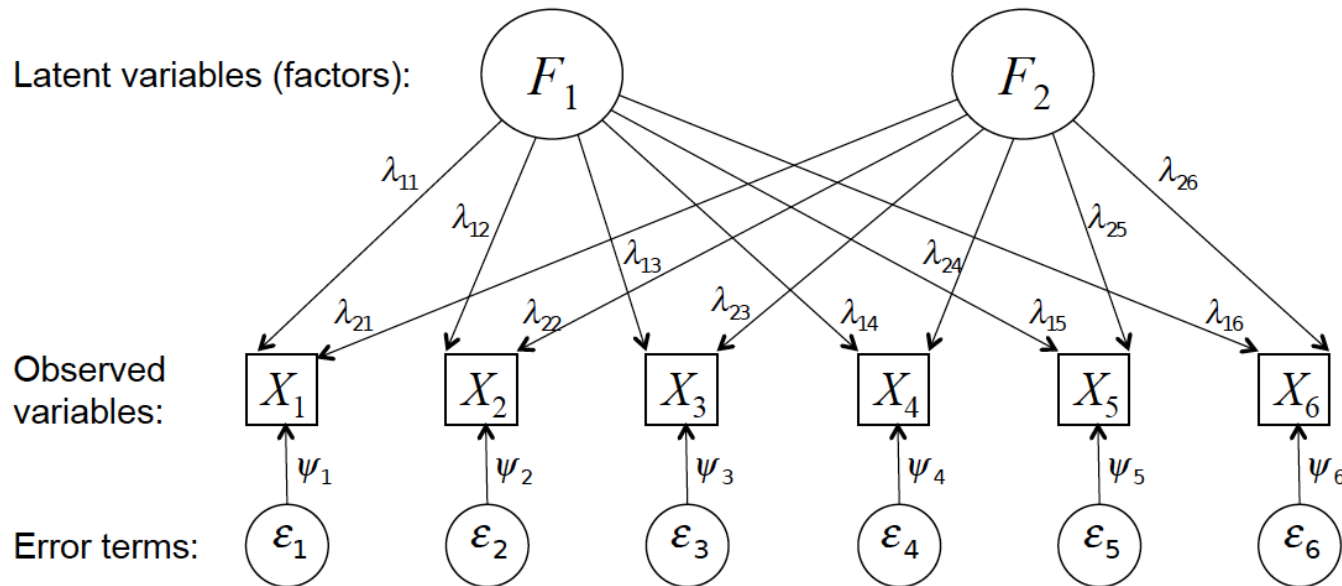


Alternate Approach: Using Surveys

- 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

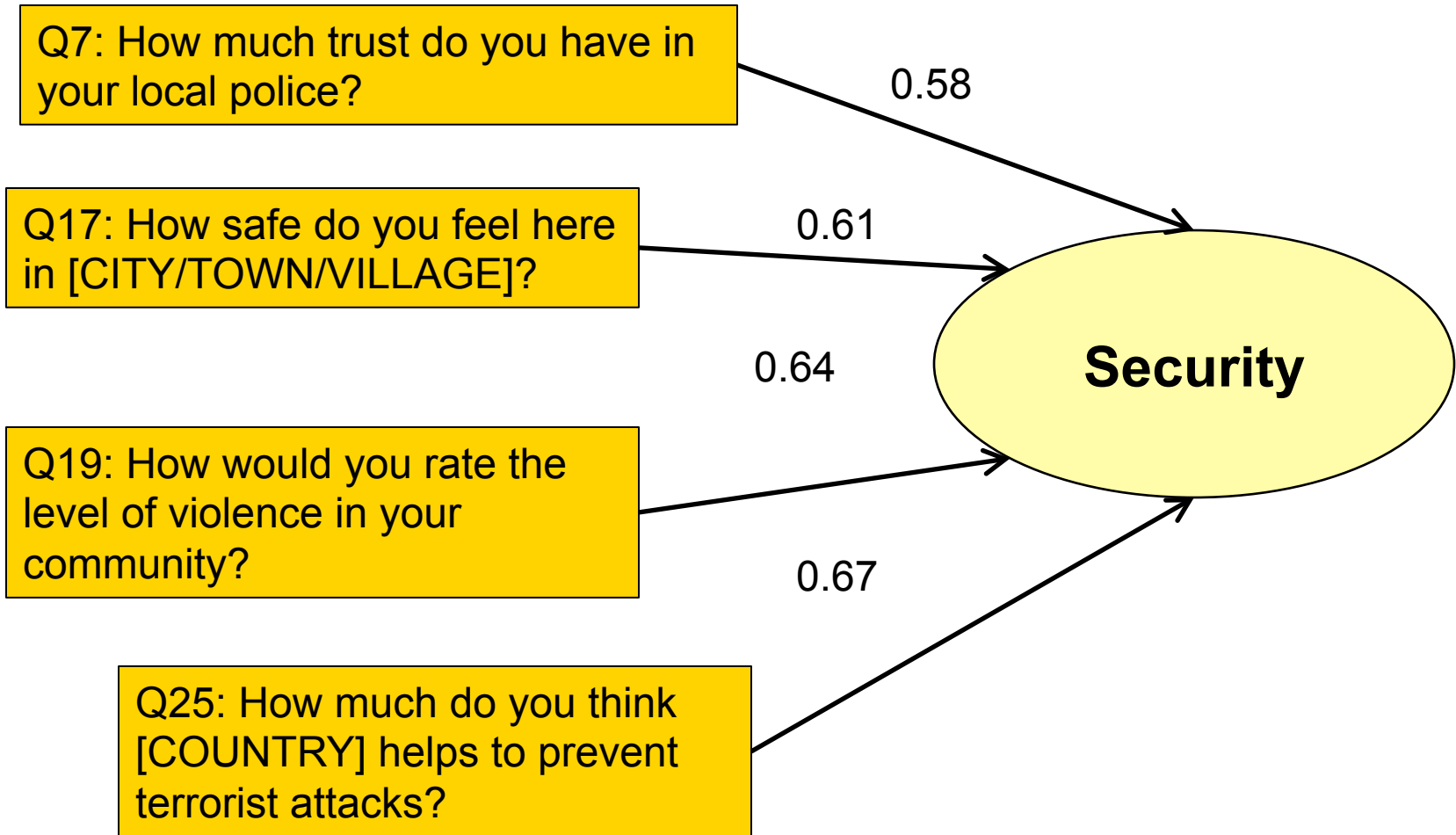
Factor Analysis

- 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



Using Factors in Models

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

$$Y = f(F_1, \dots, F_n, D_1, \dots, D_m)$$

- 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?