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## Using Survey Data to (Help) Parameterize Human Terrain Models

Fricker, Ronald D.; Jones, Steve

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Contributed paper, with MAJ Steve Jones: "Using Survey Data to (Help) Parameterize Human Terrain Models," 2nd International Conference on Cross-cultural Decision Making, San Francisco, CA, July 2012.

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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

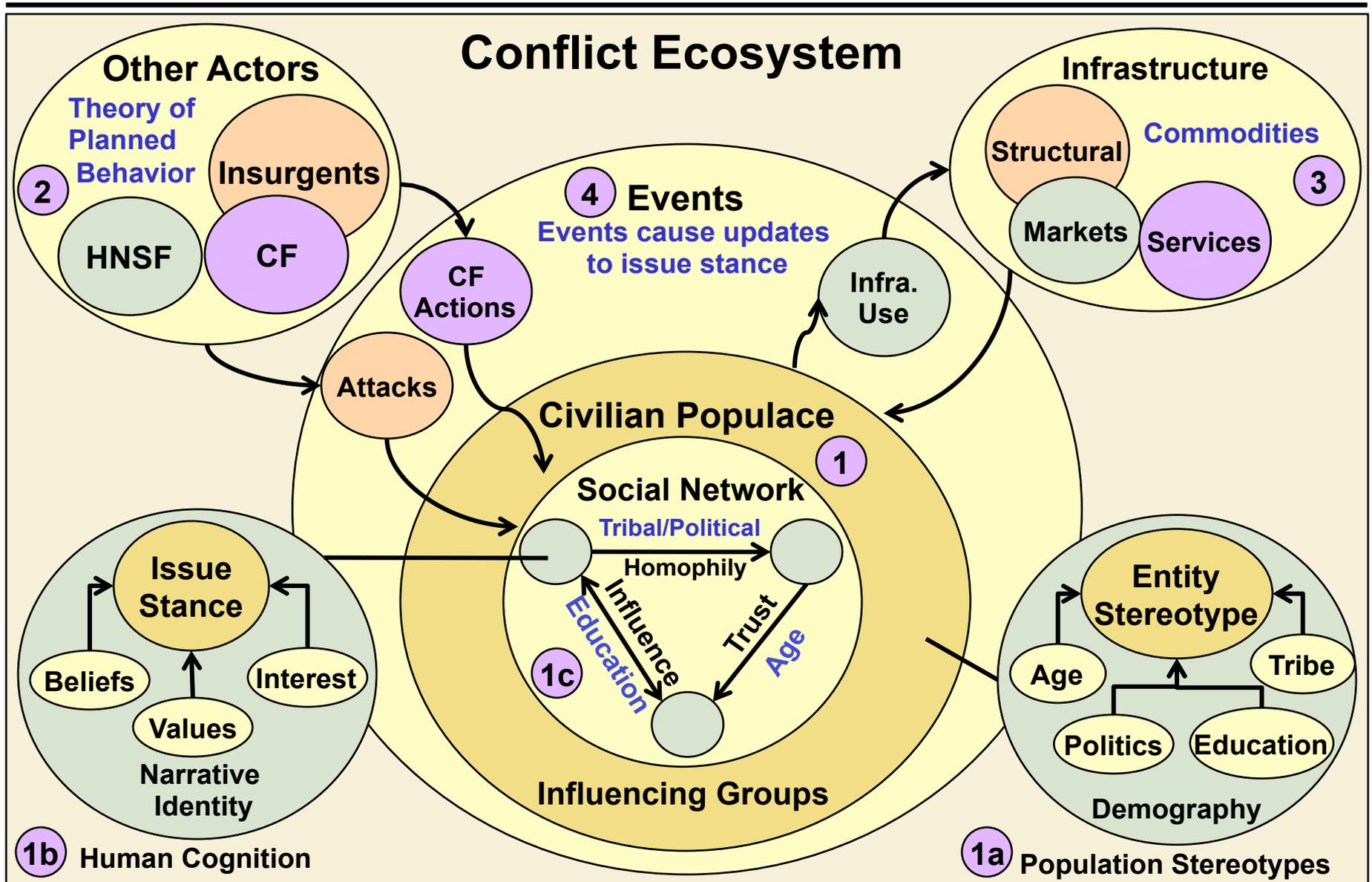
# The Problem

*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.”

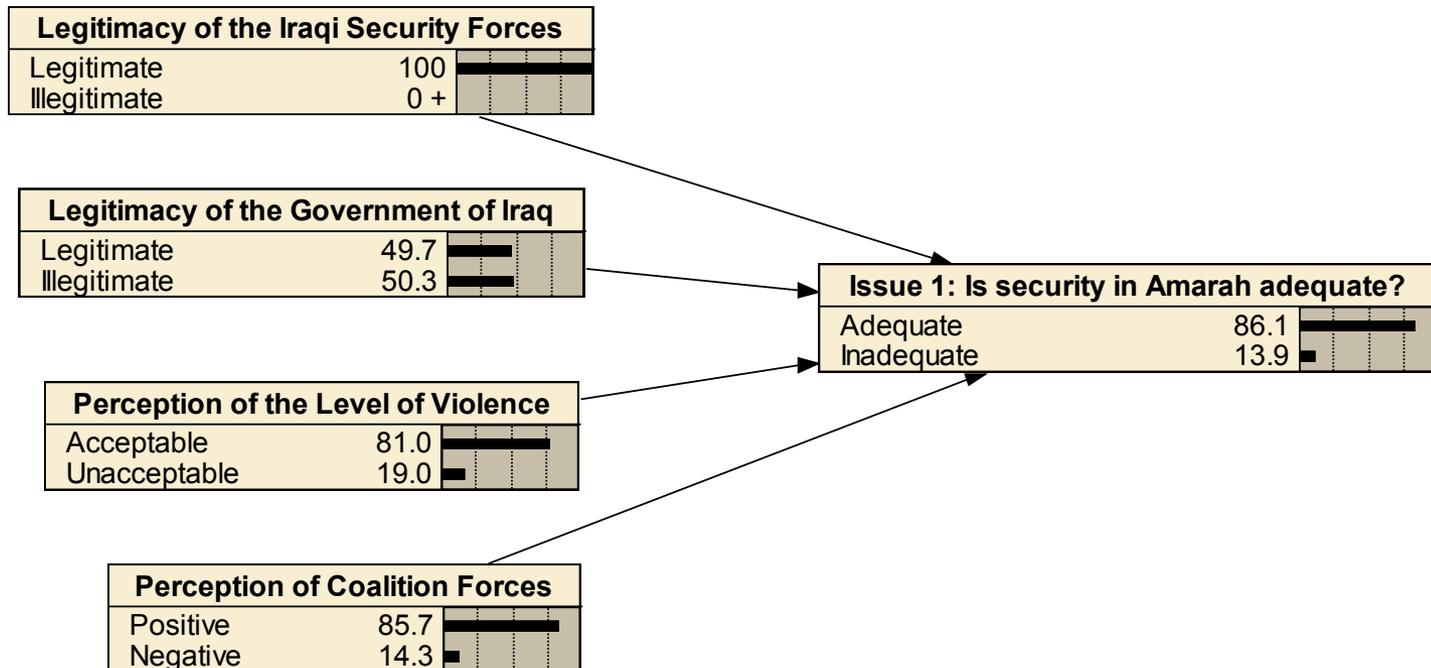
COUNTERINSURGENCY (FM 3-24/ MCWP 3-33.5)

- 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

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- 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?



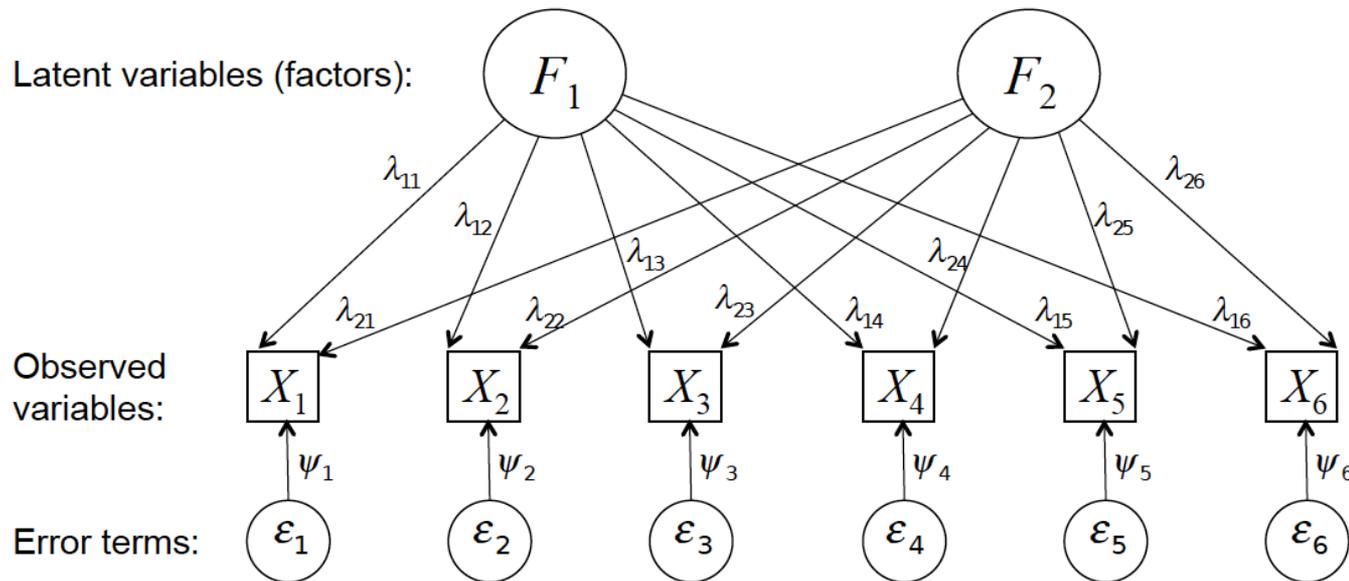
# Alternate Approach: Using Surveys

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- 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

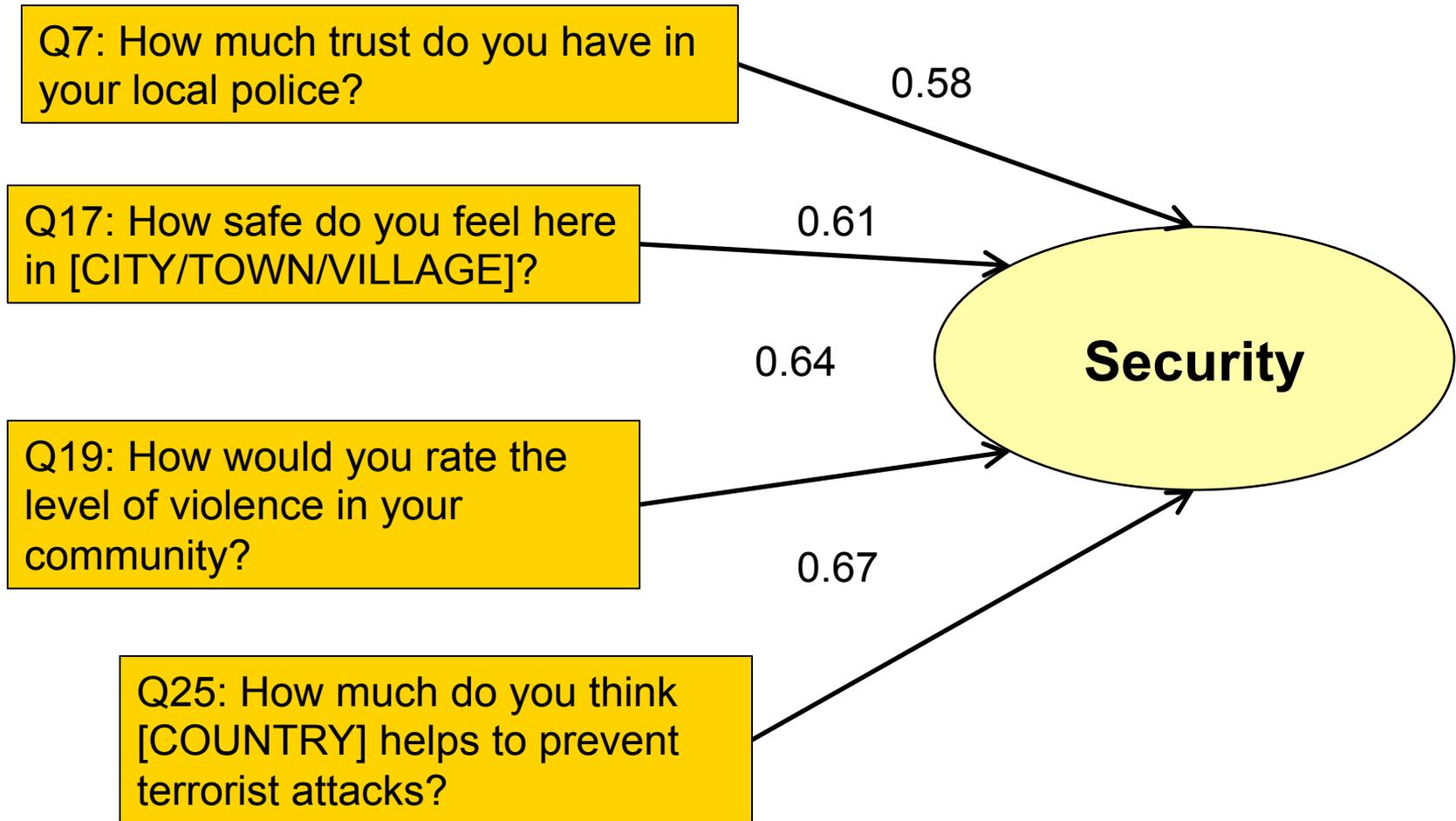
- Factor analysis models the covariance of observed variables as linear combinations of unobserved (latent) variables
  - Factors should achieve both “statistical simplicity and scientific meaningfulness” (Harmon, 1976)



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

# Factor Analysis Example

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# Using Factors in Models

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- 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

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- 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

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- 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?