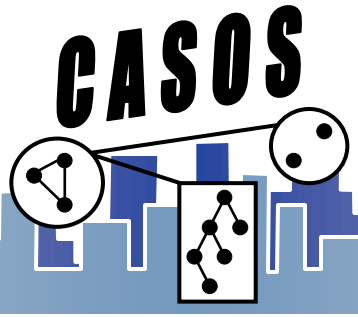

Virtual Experiments

Geoffrey Morgan
Geoffrey Dobson

institute for SOFTWARE RESEARCH

Carnegie Mellon

Center for Computational Analysis of
Social and Organizational Systems
http://www.casos.cs.cmu.edu/

What are Virtual Experiments?

- Virtual Experiments are like experiments, but they involve testing a model rather than testing reality.
  - We keep the descriptor "virtual" to remind ourselves that these are not 'truths' we are discovering, but instead truth as the model predicts.
  - The assumptions of the model must always be kept in mind when considering the results of the model.
  - "All models are wrong, but some are useful."

- Many of the same principles involved in designing an experiment must also be kept in mind when designing a virtual experiment.

When to use Virtual Experiments?

- When testing with real people is:
  - Too expensive
  - Unethical
  - Infeasible

- You should not use it:
  - When you can get what you want from a survey (most surveys are going to be cheaper than building and testing a model)
  - When you're looking for 'truth' and not 'trends'

Caveats to VEs

- There are serious, sometimes skirted issues with computational models. You're not working with real people, so
  - You have to buy the model of how people work to buy the results
  - You have to code the model to get the results
  - Writing code without bugs isn't easy

(Some) Key Assumptions in Construct

- Agent-Orientation – The phenomenon of interest can be modeled through the actions and interactions of individual agents (of whatever grain size).
- Network Representation – Connections between actors can be represented as one or more networks.
- Homophily – Agents prefer to interact with other agents similar to themselves.
- Expertise-Seeking – Agents prefer to interact with agents that have rare knowledge.
- Turn-Taking – Agents are relatively equivalent in their ability to react to events, and thus fixed time blocks are appropriate.

Virtual Experimentation

- As stated before, many of the same problems of general experimental design come up in Virtual Experimentation

- Dependent Variables
- Independent Variables
- Method (non varying but still need to be set parameters)
- Control Conditions
- Generality
- Power (repetitions)

Independent Variables

- What am I changing?
- For Virtual Experiments, this should both be the variable name, and what values you intend it to have.
- **Be careful of combinations explosion – too many independent variables and it'll take 100 years to run your simulations.**

Dependent Variables

- What am I measuring?
- Is what I am measuring a good analog to the thing I want to measure (in the real world)?
- Do I have some reason to believe that what I'm manipulating will change the values of what I'm measuring?

  But it's not a direct manipulation!
- **Its easy to think of tens of metrics you want to think about. There is likely one or two that best fit your RQ

Method

- For Virtual Experiments, much of the 'method' is in setting variables that are not being manipulated but still must be specified.

- There are three reasonable strategies for these variables
  - Set them so they don't have any impact
  - Set them to a reasonable base-line
  - Have the variable set randomly across an appropriate distribution

When would you use any one of these methods?

Control Conditions

- Not really the same as in a standard experimental design.
- In a Virtual Experiment – control conditions are settings of the independent variables least likely to have any effect on the phenomena of interest.
- With network topologies, ER Random networks are often used as a control condition for topologies.
  - This is despite the fact that ER Random networks are not very realistic!

Generality

- Defining model parameters can become very specific – the source of parameters should always be drawn from literature.

- Example: Examining network information flow after actor removal.
  - Bad example:
    - Case 1: Remove Gordon
    - Case 2: Remove Jill
    - Case 3: Remove Pat
  - Good Example:
    - Case 1: Remove Actor with highest degree centrality
    - Case 2: Remove Actor with highest betweenness centrality
    - Case 3: Remove Actor with highest eigenvector centrality

Power

- Given enough repetitions, even trivial differences between simulation conditions will produce statistically significant results.
- It's important to focus on trends, rather than specific values.
  - Wrong: Because of the manipulation condition, Y increases by 5%.
  - Better: Y tends to increase under the manipulation condition.
- A reasonable heuristic is 25 repetitions per combination

Example

How does varying the degree of ethnocentrism in an artificial society affects the formation of social relationships across social groups under different models of the underlying cultural structure?

Joseph, K., Morgan, G. P., Martin, M. K., & Carley, K. M. (2013). On the Coevolution of Stereotype, Culture, and Social Relationships: An Agent-Based Model. *Social Science Computer Review*.

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Virtual Experiment

Parameters	Values Taken
Parameters of Interest	
Initial knowledge distribution	random, group based, all same
Initial Bias Parameter (IBP)	0, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1
Other Parameters Varied	
Group Activation Threshold (GAT)	-5, -1
Group Learning parameter (GLP)	5, 25, 50
Individual Activation Threshold (IAT)	-1, 0
Constants	
Number of Simulation Turns	150
Number of Agents	1000
Number of Knowledge Bits	500
Number of Interactions	2
Number of Knowledge bits passed per interaction	1
Density of knowledge (percent of bits set to 1)	0.4
Decategorization Parameter (DP)	6
Groups Per Agent	1
Total number of groups	4
Repetitions	
Number of repetitions	10
Total Runs	3*11*2*3*2*10 = 3960

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Analyzing the results

- Run the simulation
- Construct a network of who talked to who more than N (N=2 here) times
- Look at the *log-odds* of a tie to a member of the outgroup

$$log_2\left(\frac{\#relations\ connecting\ two\ agents\ in\ different\ groups + 1}{\#relations\ connecting\ two\ agents\ in\ the\ same\ group + 1}\right)$$

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Results from VE

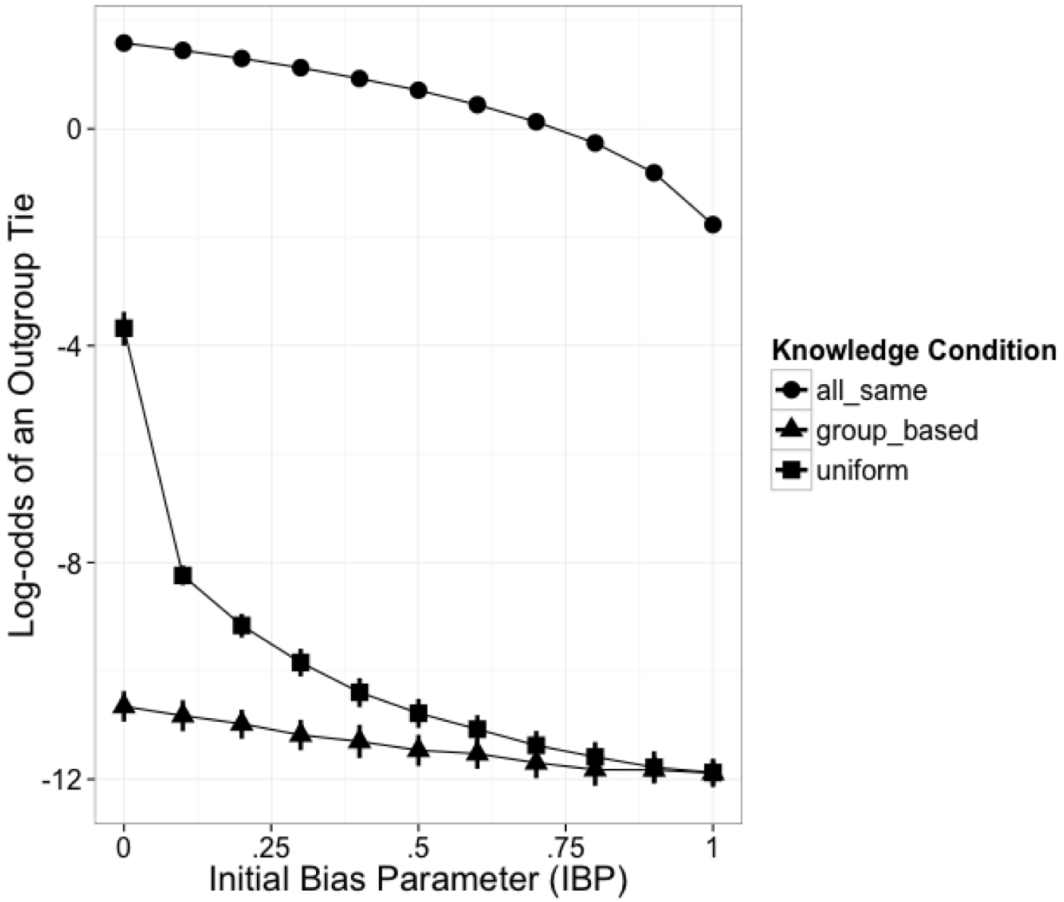
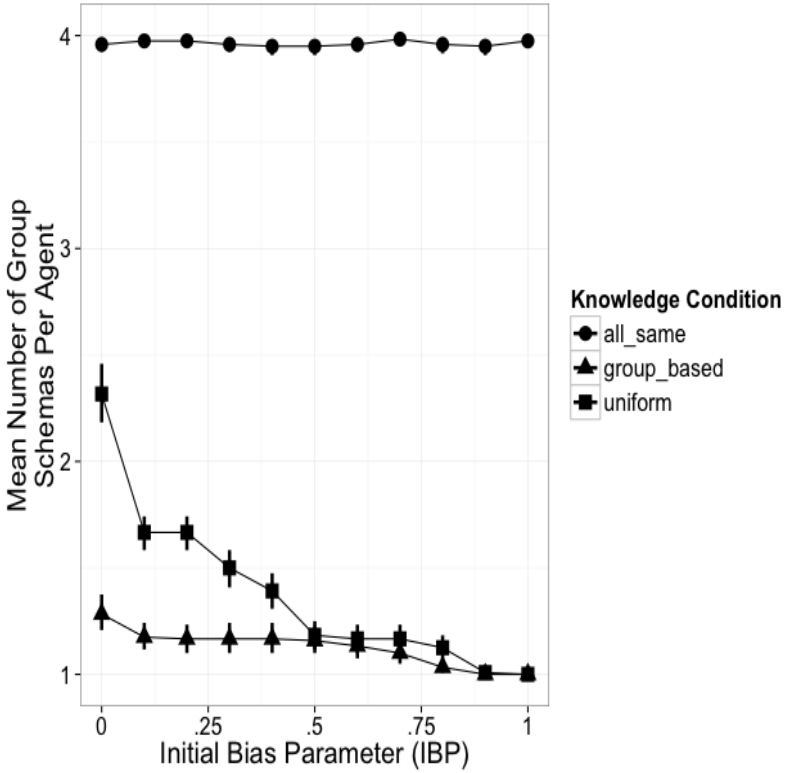


Figure 4- The x-axis represents the ten different IBP conditions and the three different shapes of points represent knowledge conditions. The y-axis gives the log-odds of an out-group tie, and lines connect the mean outcomes across the different conditions. Ninety-five percent (95%) bootstrapped confidence intervals are drawn at each IBP condition.

CASOS

Results from VE



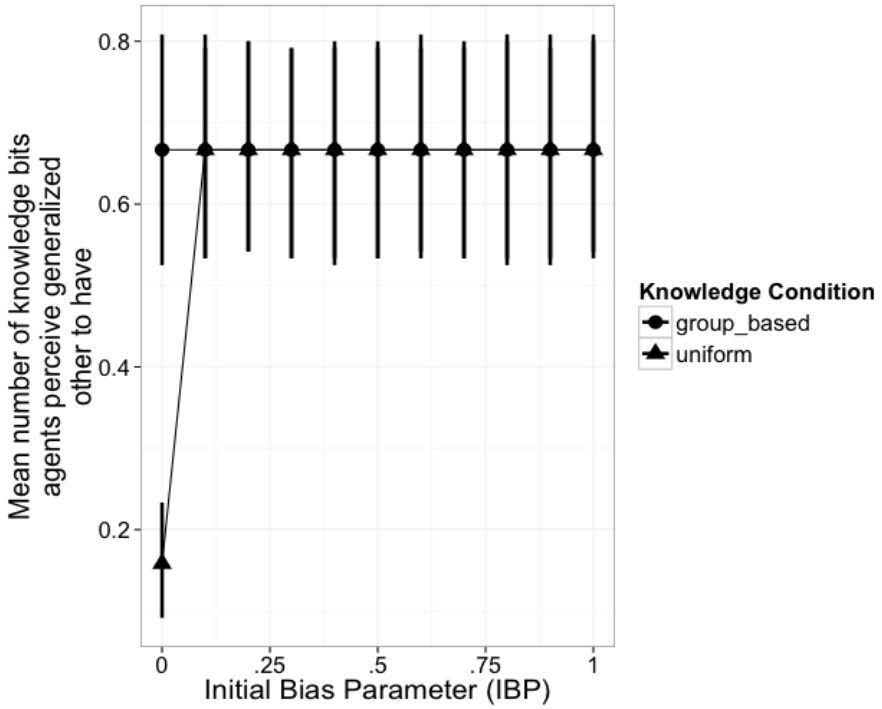


Figure 5a) The mean number of group schemas that agents held across all conditions. 5b) The mean number of knowledge bits that the generalized other schema had set to 1 across all agents in the group based and uniform knowledge conditions only. Error bars are 95% bootstrapped confidence intervals

Conclusions from VE

- The model generated results that were sort of obvious
  - In my eyes, this is a good thing!
  - What do you think?
- Results suggested that neither stereotypes nor the form of underlying cultural structures alone are sufficient to explain the extent of social relationships across social groups
- Rather, we provide evidence that shared culture, social relations and group stereotypes all intermingle to produce macro-social structure.
- What do you think should be next?
  - Cross-cutting groups
  - Differentiating in-group love from out-group hate