

FRONTIERS OF AGENT-BASED MODELING

AARON BRAMSON'S
ICP4R 2009 ABM WORKSHOP Day 6

benefits and LIMITATIONS of including an ABM in your research project

- A) how to extract the most benefit from a model
 - 2) when are they most/least insightful, and
 - III) what one can't do without an ABM.
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- 4) limitations of measurement & performance
 - e) data overload and the limits of statistics
 - vi) skepticism and the inadequacy of sufficiency

current benefits

- Implicit Non-Linear Dynamics
- Feedback, Multiplier Effects, Dynamic Interactions
- Spatially Explicit Modeling (GIS, Mars Rover, Cafe Seating)
- “Medium” Number of Agents
- Evolvable/Adaptive Agents and System Characteristics
- Plagiarism of Code is Encouraged and Rewarded
- Visualizations Can Pump Intuitions
- Fun, Sexy, New Kind of Cutting-Edge Science

future benefits

- Computers are Getting Faster and Cheaper
- More Off-the-Shelf Packages Becoming Available
- Growing Research Support Community
- Recognized in Industry and Government (aka \$\$\$)
- Specialized Journals with Less Competition
- Improvements in Information Extraction (Measurements)
- Improvements in Interfaces and Visualizations
- Complexity Scientists will be the Academic Elite

current LIMITATIONS

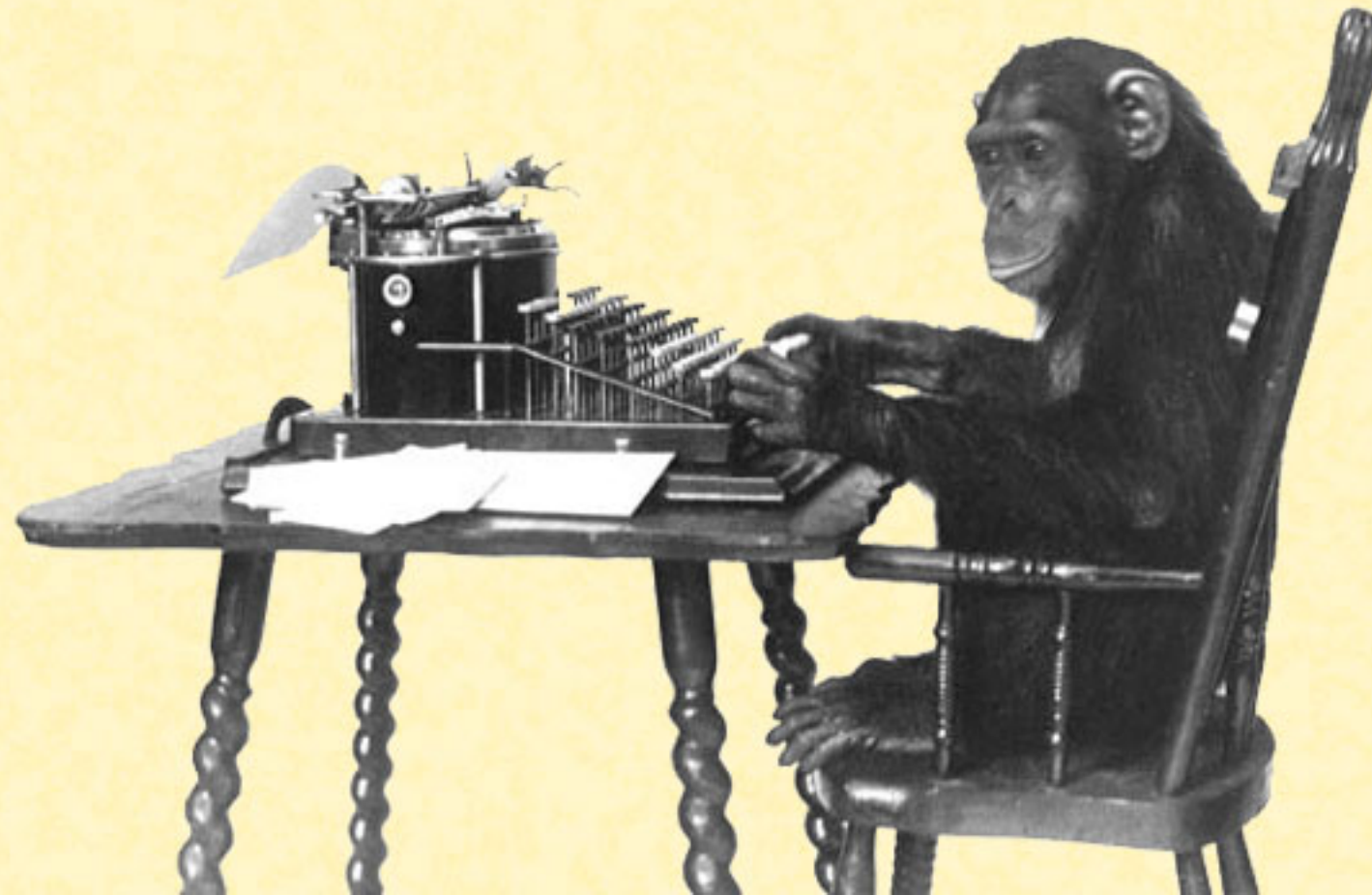
- Computer Programming is Tedious and Annoying
- ABM packages are Limited and Constraining
- Complex Systems is a Conceptual Mess
- Statistical Methods are Inappropriate for ABMs
- Few Good Measures of System Characteristics
- Research Groups are Isolated and Marginalized
- Paper Journals are not Formatted Appropriately
- Recalcitrant Traditionalists Skeptical of New Ideas

let's address these one at a time

overcoming LIMITATIONS

Computer Programming is
Tedious and Annoying

- Co-Author Your Paper with a Computer Nerd
- Pay a Grad-Student or Undergrad to Program for You
- Write a Program to Automate Parts of Programming



overcoming LIMITATIONS

ABM packages are
Limited and Constraining

- Programming from Scratch is Unnecessary Repetition
- NetLogo is Limited and Relatively Slow
- RePast is Ugly, Bulky, and Poorly Documented
- Ascape is Obscure and Poorly Documented
- Use JAVA to Customize and Expand Package Abilities
- NetLogo is Useful for Testing Ideas, and it has **EDIT**
- RePast and NetLogo are Constantly Being Improved
- Netlogo is Open to Recommendations

overcoming LIMITATIONS

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- No Solid Definition of Complexity or Emergence or ...
- People Disagree about Root Concepts (e.g. SOC vs HOT)
- “We Have a Model, but What Does it Mean?”
- Causality, Law Following, or Just Correlation?
- Wrangle Philosophers into Complex Systems
- Locate Oneself in the Logical Geography
- Recognize Link between Methods and Concepts
- Read More Philosophy!!! (Especially Metaphysics)

overcoming LIMITATIONS

Statistical Methods are
Inappropriate for ABMs

- ABMs Generate **TONS** of Data
- Reliance on Current Statistics Reduces Insight
- Measures Apply over States, not Processes
- No More Sophisticated than Observational Approaches
- Wrangle Statisticians into Complex Systems
- Research Obscure Statistical Techniques
- Recognize Limitations of Current Statics and Statistics
- Develop New Measures and Statistical Techniques

A Psychological Interlude

simultanagnosia

[sī'multan'agnō'zhə] n.

A visual disorder in which a patient can recognize objects or details in their visual field, but only one at a time. They cannot make out the scene they belong to or make out a whole image out of the details.

[THE HUMAN BRAIN]

Division of Labor in the Hemispheres



▲ Original picture

In a classic experiment, Dean C. Delis of the University of California, San Diego, and his colleagues asked brain-damaged patients to study a picture of a large capital H made up of little A's (*left*) and then redraw it from memory. The patients with damage to the right hemisphere (thus dependent solely on the left hemisphere) often simply scattered A's over the page (*below left*). Patients with damage to the left hemisphere often just drew a large capital H with no A's (*below right*). Thus, the human left brain characterizes stimuli according to one or a few details, whereas the right brain specializes in synthesizing global patterns.



Patients with damage to the right hemisphere could remember details of the original but not the overall pattern.



Patients with damage to the left hemisphere could reproduce the global pattern but not its details.

overcoming LIMITATIONS

FEW GOOD MEASURES OF SYSTEM CHARACTERISTICS

- We Don't Know What to Measure
 - Dynamic Measures are Difficult to Conceptualize
 - Previous Research Programs Didn't Need Them
 - Few Benchmarks for a Good Measure (BEST GUIDE is INTUITION)
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- Wrangle Mathematicians into Complex Systems
 - Research Obscure Mathematical Techniques
 - Identify Desiderata for Measures of Processes
 - Discover/Invent a New Branch of Mathematics

overcoming LIMITATIONS

RESEARCH GROUPS ARE
ISOLATED AND MARGINALIZED

- Few Departments of Complex Systems Exist
- Few Journals Accept Non-Mainstream Ideas
- Too Small a Community for Many National Conferences
- Education Systems Change Slower than Climate
- Develop Unified Curriculum for Complex Systems
- Demonstrate Relevance and Similarity to Extant Research
- Create Sessions with Sexy Titles at Popular Conferences
- Write Letters, Send E-mails, Yell “We Want Degrees!!”


overcoming LIMITATIONS

Paper Journals are
Not Formatted Appropriately

- Journal Articles Are Typically too Short to Describe Model
- Predominantly Black and White Printing
- No Interaction; Audience Can't See It Working
- Utilize/Start Online Journals and Article Repositories
- Wait until Everyone Buys a Tablet PC to Read from

overcoming
LIMITATIONS

RECALCITRANT
TRADITIONALISTS
SKEPTICAL OF NEW IDEAS

- Advisor Doesn't Like/Trust Complex Systems/AMBs
- Need to Spend Time Mastering Old Techniques
- Can't Get a Job in a Typical _____ Department
- Friends and Family Have No Idea What You're Studying
- Use Terminology that People Are Used To
- Take Extra Time to Earn Your Degree 
- Get A Job in Industry/Government (More \$\$\$ too)
- Complex Systems Sounds Impressive
- Memorize Some Good Slogans and Few Simple Examples

In Summary,

ABMs are Awesome!!!

Tell Everyone.