Simulation and Misinformation Lecture 3

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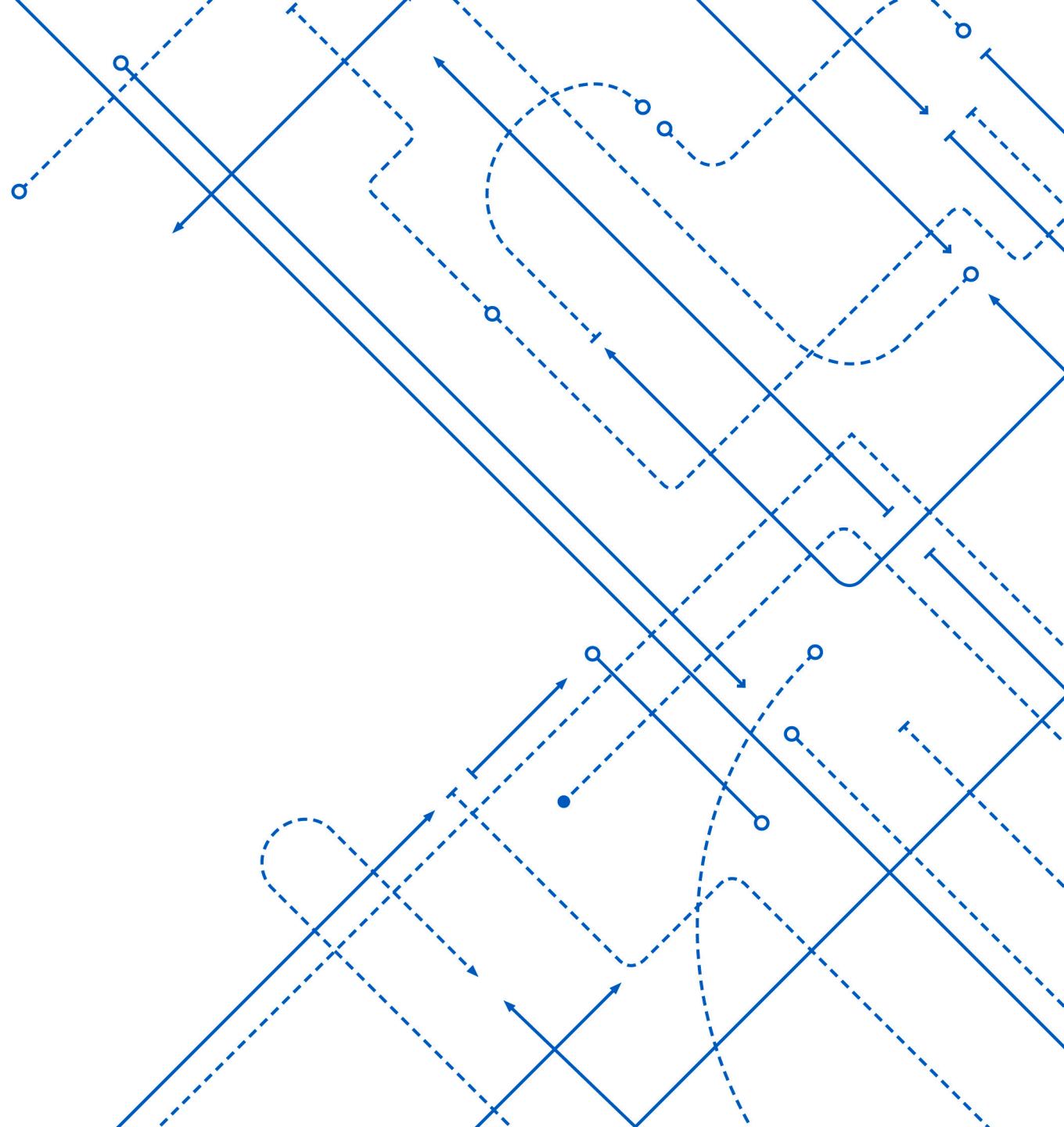


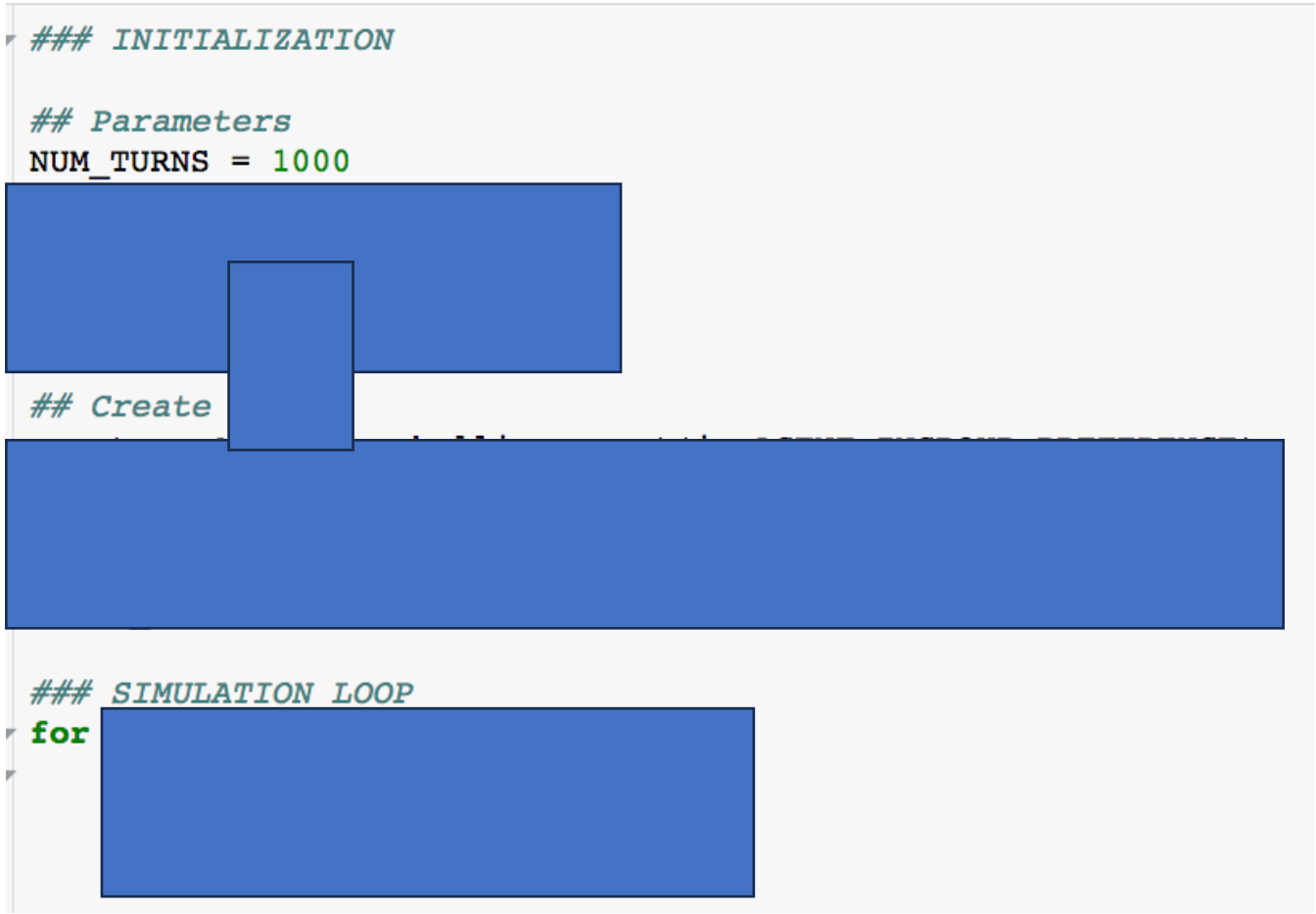
Jessica Nordell

Schumer, NSF director say UB is ready to lead nation in AI for social good

Preparing to cut the ribbon to open the National AI Institute for Exceptional Education are (from left) Sahana Rangasrinivasan, a computer science and engineering PhD candidate; NSF Director Sethuraman Panchanathan; U.S. Senate Majority Leader Chuck Schumer; President Satish K. Tripathi and Venu Govindaraju, vice president for research and economic development, and principal investigator of the AI institute. Photo: Nancy J. Parisi

AM Activity: actually coding an agent-based model up

- Schelling's model is an **agent-based model**. In agent-based models, we often talk about two things:
  - **Model initialization**
  - The **simulation loop**.
- Task:
  - Initialize the model
  - In 5 lines or less, write the simulation loop
  - Hint: your function names can be extensive (do_...._)



Actually coding an agent-based model up

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```
### INITIALIZATION

## Parameters
NUM_TURNS = 1000
NUM_AGENTS = 500
BOARD_X_SIZE = 25
BOARD_Y_SIZE = 25
AGENT_INGROUP_PREFERENCE = .3

## Create Agents
agents = [create_schelling_agent(i, AGENT_INGROUP_PREFERENCE)
              for i in range(NUM_AGENTS)]
board = create_board(BOARD_X_SIZE,
                     BOARD_Y_SIZE)
place_agents(board,agents)

### SIMULATION LOOP
for turn in range(NUM_TURNS):
    for agent in randomize(agents):
        do_agent_move(agent)
    print_results(board)
```

Why simulate?

Too complex and too much drawing – limited computation possible

Too simple – can prove things but you're making overly bold assumptions

Causal diagramming

Theoretical Modeling

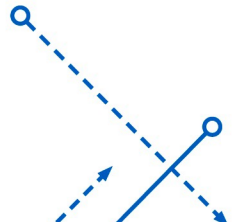
Simulation

Thinking through this: Ensign vs Lum & Issac

- What does the simulation do that the theoretical model doesn't?
- What about vice-versa?
- What do they both do that causal diagramming could not?
- Rhetorical: What does this tell us about how these tools can help us understand ML & Soceity?

Simulation

- Can help us understand how *micro-level behaviors* impact *macro-structure*, and vice versa, in potentially non-obvious ways
  - Prisoner's Dilemma (later today)
  - HW: Contagions
- Can help us "experiment" (**virtually)** quickly and/or when it is impossible/unethical to do so otherwise
  - Class: How might we "fix social media"?
  - HW: PRISM
  - HW & Class: Your Project



Virtual Experiments

Geoffrey Morgan
Michael Lanham
Kenny Joseph

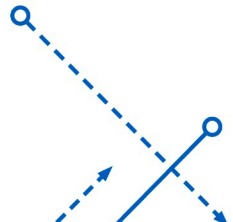
What are Virtual Experiments?

- 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.
- 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?

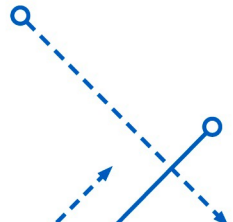
- When testing with real people is:
  - Too expensive
  - Unethical
  - Infeasible

- 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'

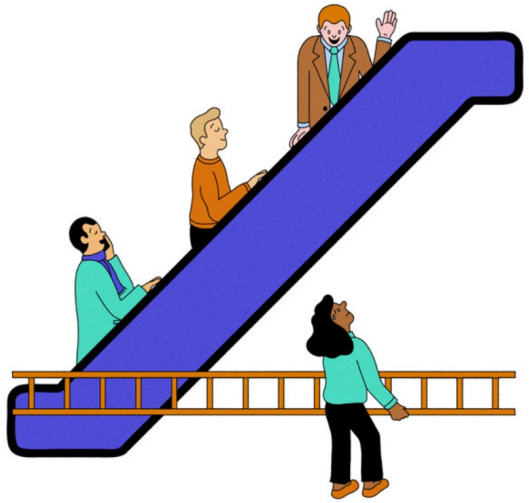


Caveats to VEs

- 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



Example



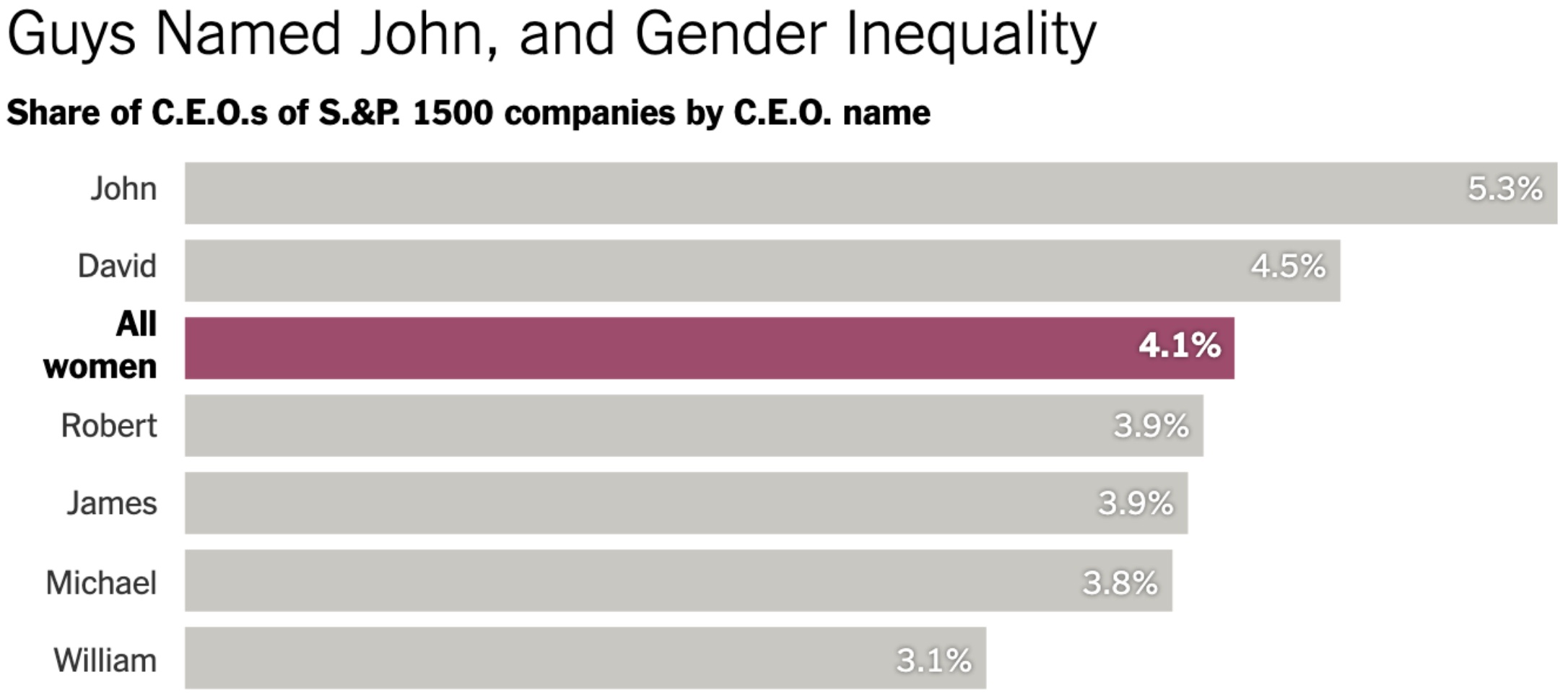
Melanie Lambrick.

OPINION

This Is How Everyday Sexism Could Stop You From Getting That Promotion

https://www.nytimes.com/interactive/2021/10/14/opinion/gender-bias.html

The glass ceiling



https://www.nytimes.com/2015/03/03/upshot/fewer-women-run-big-companies-than-men-named-john.html

Why the glass ceiling?

Why the glass ceiling?

Subtle biases and micro-aggressions pile up, few of which on their own rise to the level of 'let's take action,' but are insidious nonetheless.

https://nextpittsburgh.com/features/lenore-blum-speaks-out-about-sexism-in-the-workplace/

Why the glass ceiling?

- Many, many empirical studies, both qualitative and quantitative
- But empirical work tends to (necessarily!)
  - Focus on one or a few (emergent) causes
  - Struggles to study the continuous, small, long-term discrimination faced by women in the workplace

Research Questions:

- How do small, empirically-observed gender biases/microaggressions lead to macro-level gender disparities? [The "think through this real world thing using a simulation model" part]
- What might we do about it? [The virtual experiment part]

Explaining our model & work

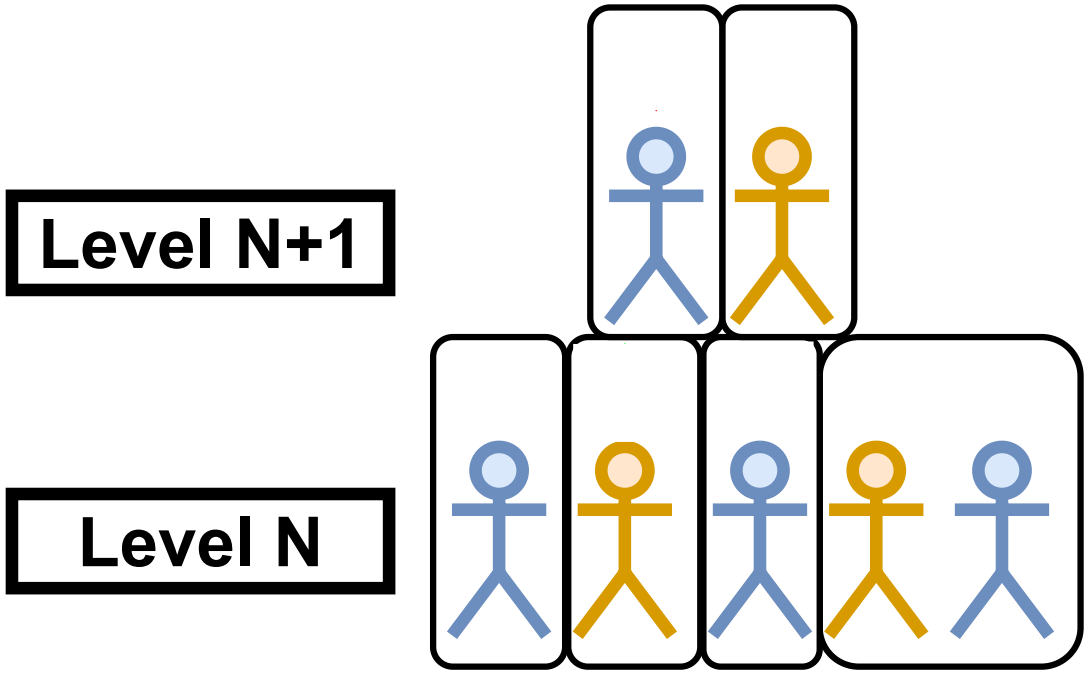
Setting up the model

1. A basic model of how promotions happen in companies
2. Small acts of **interpersonal** discrimination can add up to significant gender disparities in corporation.
3. Societal gender bias (**macro norm**) and company culture (**meso norm**) collaboratively impact gender bias within corporation

Virtual Experiment

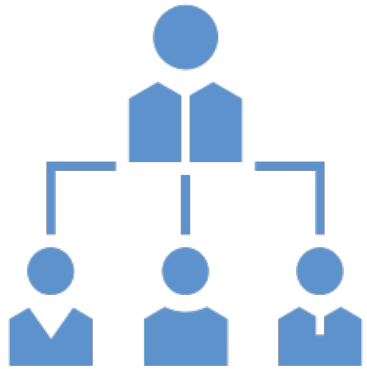
1. Effectiveness of quota-based interventions

cUBE lab



Project Turn

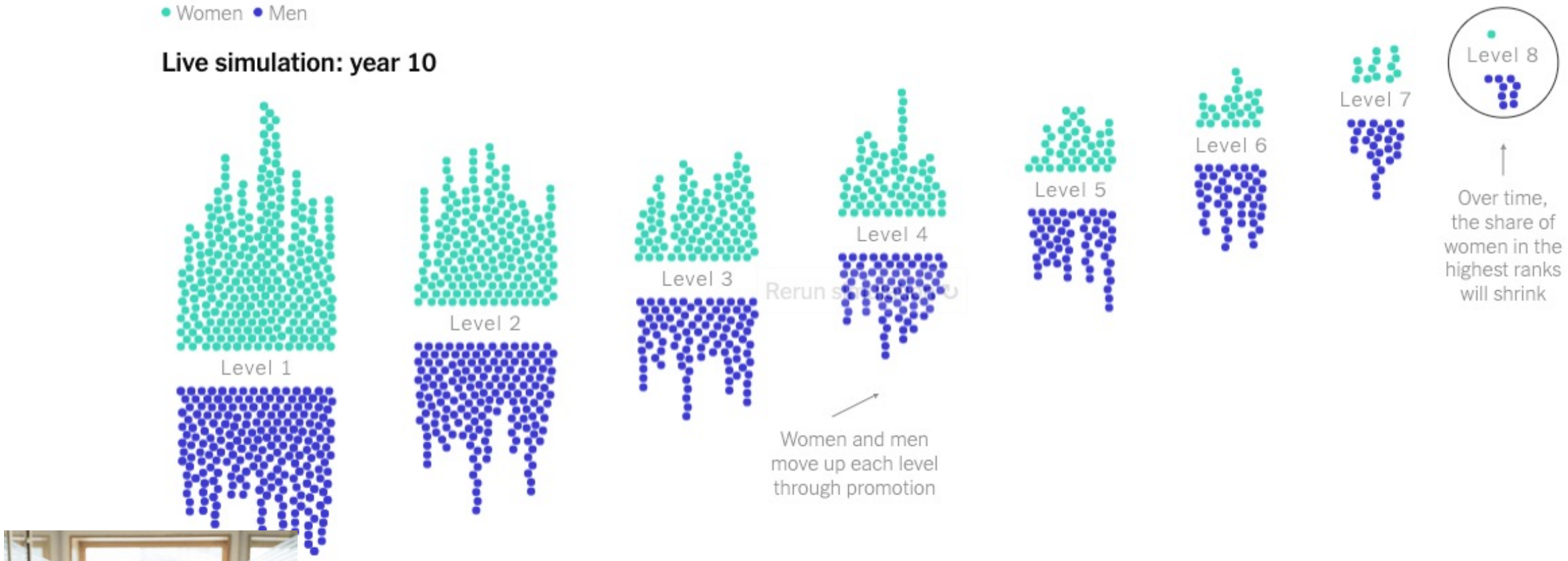
The simulation is **initialized** with a corporate hierarchy of men and women with an initial, random, **perceived promotability**

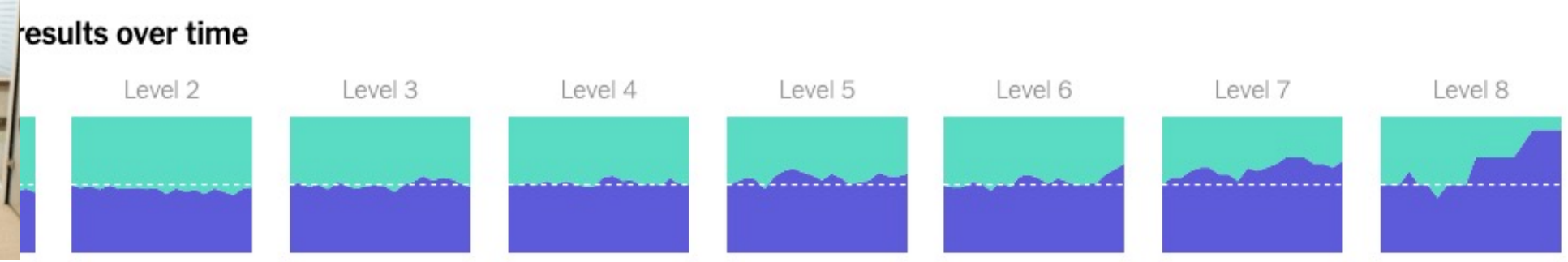


Based on their perceived promotability, individuals are(n't) **promoted**

Individuals do **projects** that succeed or fail. This influences their perceived promotability

Act 1


Women
Men
Live simulation: year 10
Level 1
Level 2
Level 3
Level 4
Level 5
Level 6
Level 7
Level 8
Over time, the share of women in the highest ranks will shrink
Women and men move up each level through promotion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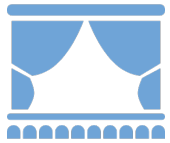
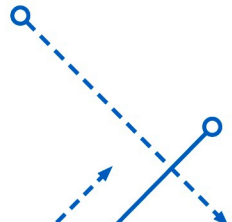


Act 2

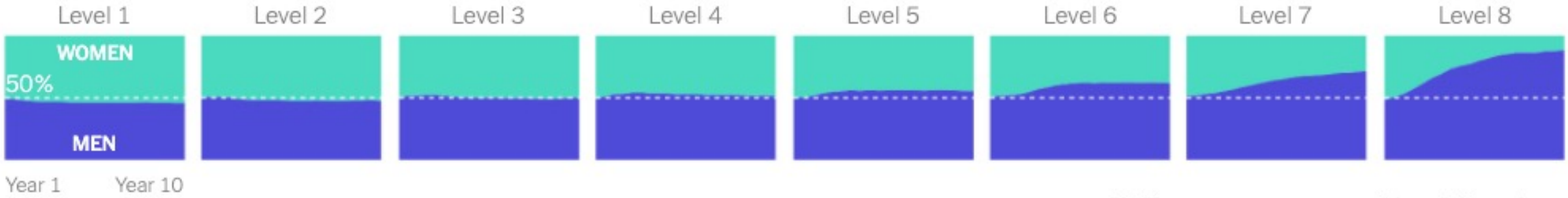
1. Women's successes on projects are valued less than men's - Women receive a smaller increase in their perceived promotability when a project succeeds
2. Women's errors and failures on projects are penalized more than men's - Women receive a greater decrease to their perceived promotability when a project fails
3. Women receive less credit in mixed-gender teams
4. Women receive more blame when a mixed-gender team fails
5. Women are penalized for exhibiting non-altruistic behavior
6. Women receive fewer opportunities for growth



Small change, big difference

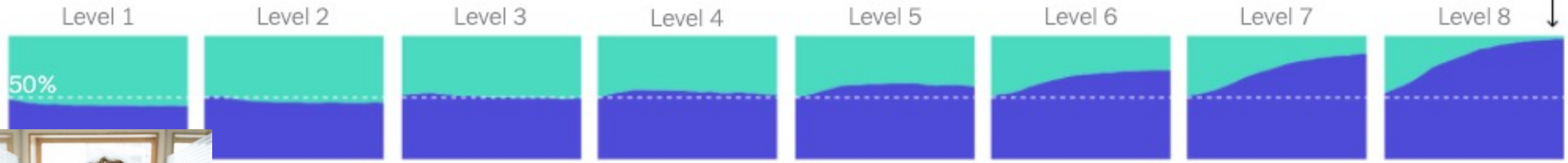
Even a tiny increase in the amount of gender bias could lead to dramatic underrepresentation of women in leadership roles over time.

Women's performance is valued 3 percent less

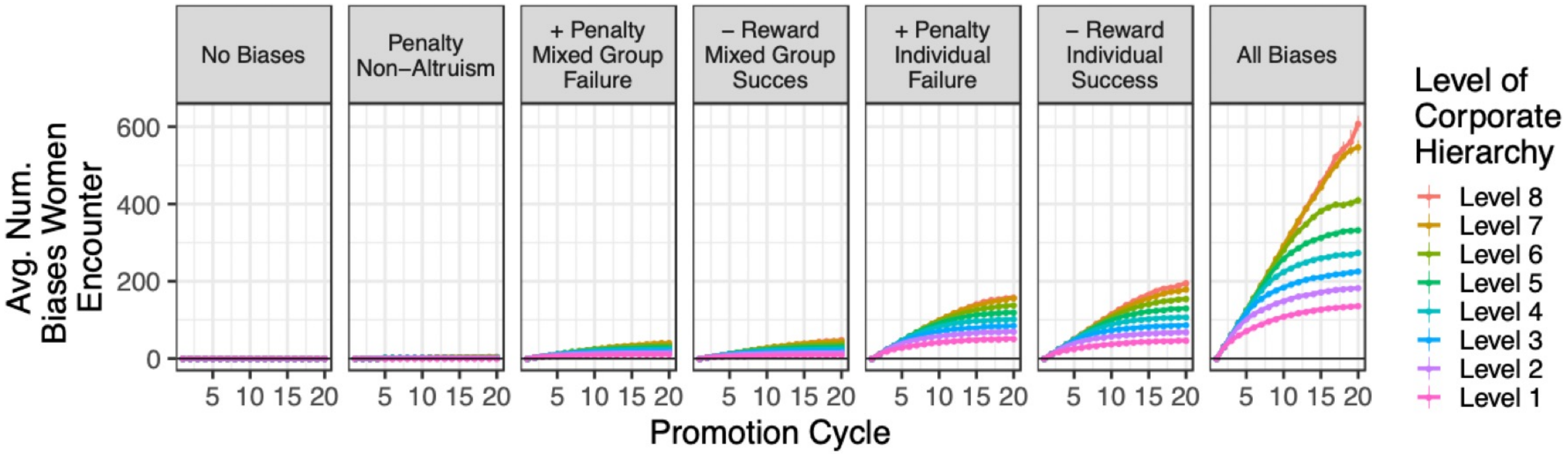


Half as many women at level 7 and only 2 percent of women at C-suite.

Women's performance is valued 5 percent less



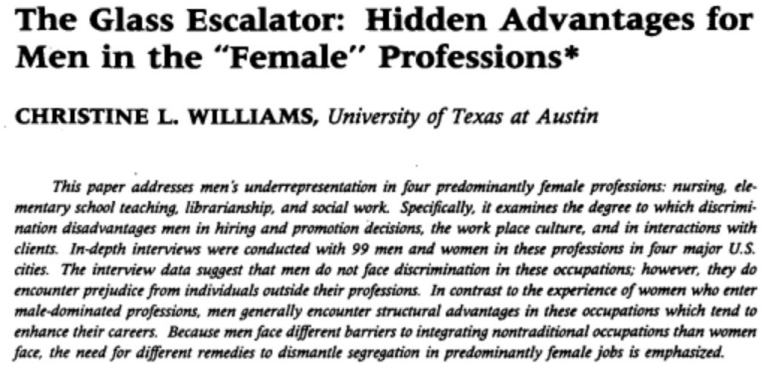
Note: Average result based on 100 simulations.



The biggest impacts are from factors **frequently applied**

A "Problem" with Act 1

1. Our model as stated doesn't explain *why women are discriminated against and not men*
   - Most other models rely on a kind of prototyping argument. But…



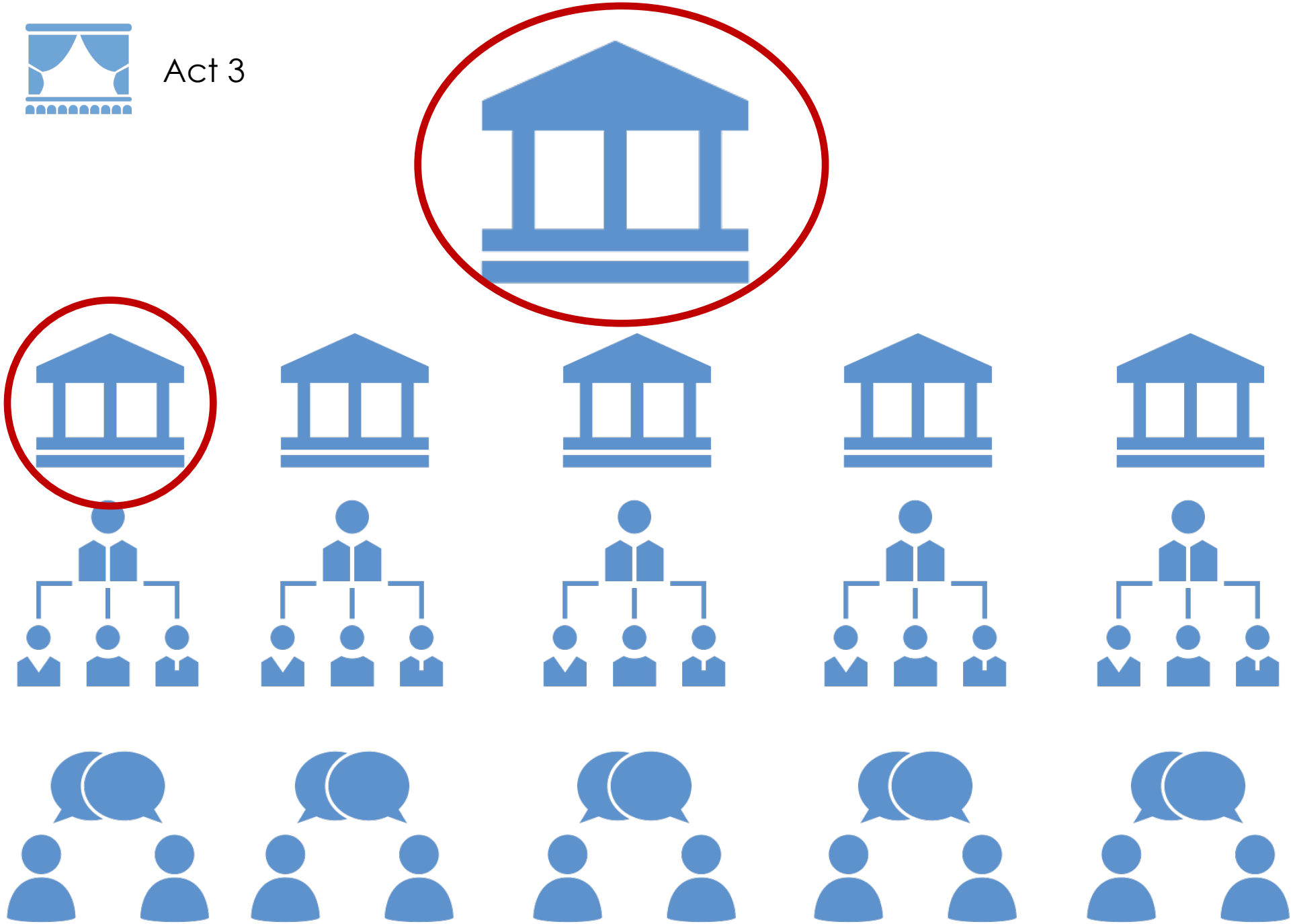
The Glass Escalator: Hidden Advantages for Men in the "Female" Professions*

CHRISTINE L. WILLIAMS, *University of Texas at Austin*

This paper addresses men's underrepresentation in four predominantly female professions: nursing, elementary school teaching, librarianship, and social work. Specifically, it examines the degree to which discrimination disadvantages men in hiring and promotion decisions, the work place culture, and in interactions with clients. In-depth interviews were conducted with 99 men and women in these professions in four major U.S. cities. The interview data suggest that men do not face discrimination in these occupations; however, they do encounter prejudice from individuals outside their professions. In contrast to the experience of women who enter male-dominated professions, men generally encounter structural advantages in these occupations which tend to enhance their careers. Because men face different barriers to integrating nontraditional occupations than women face, the need for different remedies to dismantle segregation in predominantly female jobs is emphasized.

How can we explain gender bias without the prototyping argument?

Act 3



Social norms are **hierarchical**!

Both **meso** and **macro** level norms influence gender bias

Act 3

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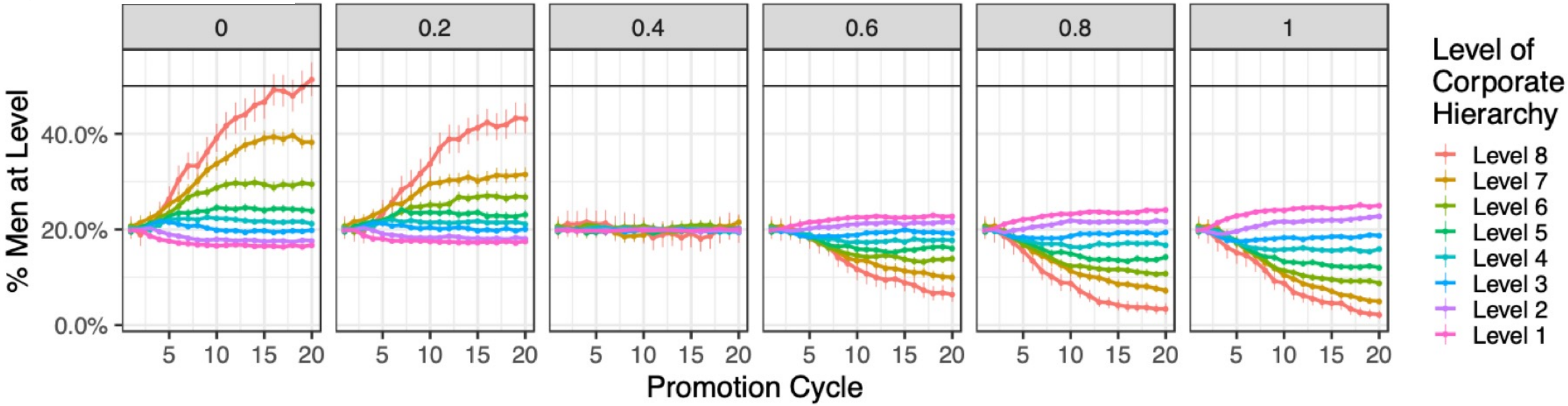
Very Rare (but what a model without hierarchical norms predicts)!



Both meso and macro norms are a necessity to model empirical observations of glass ceilings and escalators

What might we do about it?
What about **quotas?**
Let's test it!

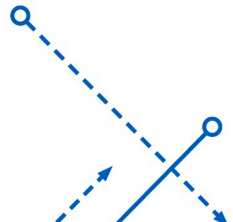
Parameter	Value
n_{sim}	2400
B_{macro}	0.044
$\widetilde{B}_{macro}$	0.044
w_0	0.5
w	{0.4,0.7,1} (Moderate, Low, No Macro Norms, respectively)
K	{10,40,70}
I_{range}	{[168,240],[168,312],[168,384]} (3, 6, 9 Prom. Cycles, respectively)
P_{female}	0 %

Table A5. The specific parameters of the model of the experiment to test the effect of a quota intervention on gender disparities. The experiment is carried out for each combination for values in the curly bracket combined with values for other parameters.

Virtual Experimentation

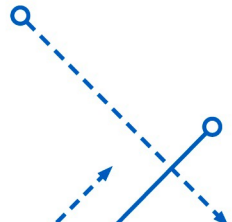
- As stated before, many of the same problems of general experimental design come up in Virtual Experimentation

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



Independent Variables

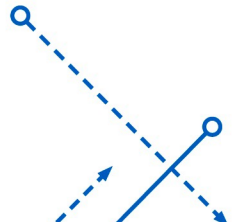
- What am I changing?
- For Virtual Experiments, this should both be the variable name, and what values you intend it to have.
- **Be careful of combinatoric explosion – too many independent variables and it'll take 100 years to run your simulations.**



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

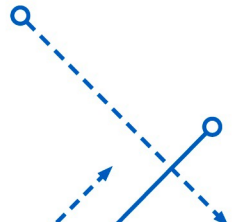
- For Virtual Experiments, much of the 'method' is in setting variables that are not being manipulated but still must be specified.

- 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 dependent 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!



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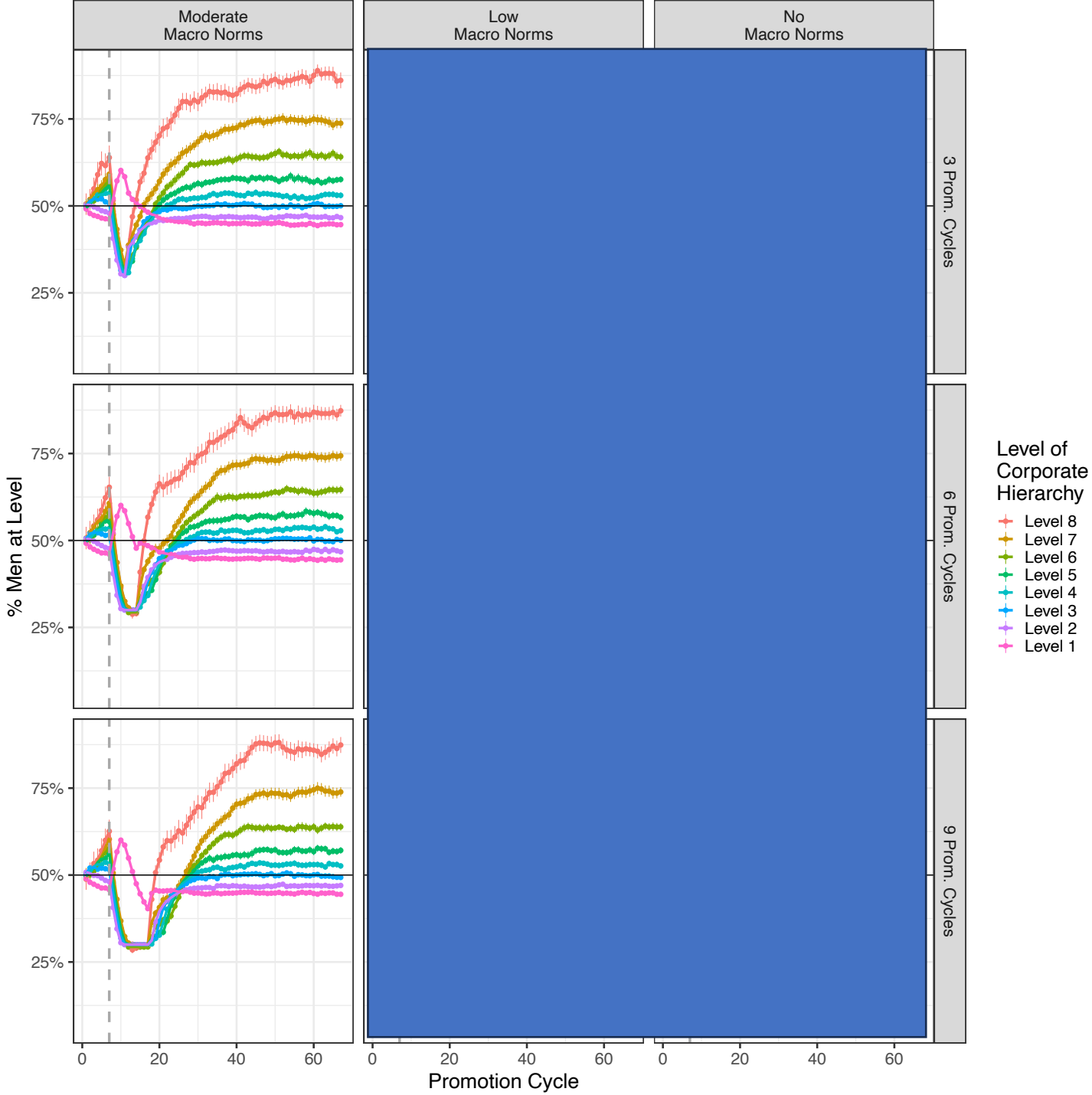
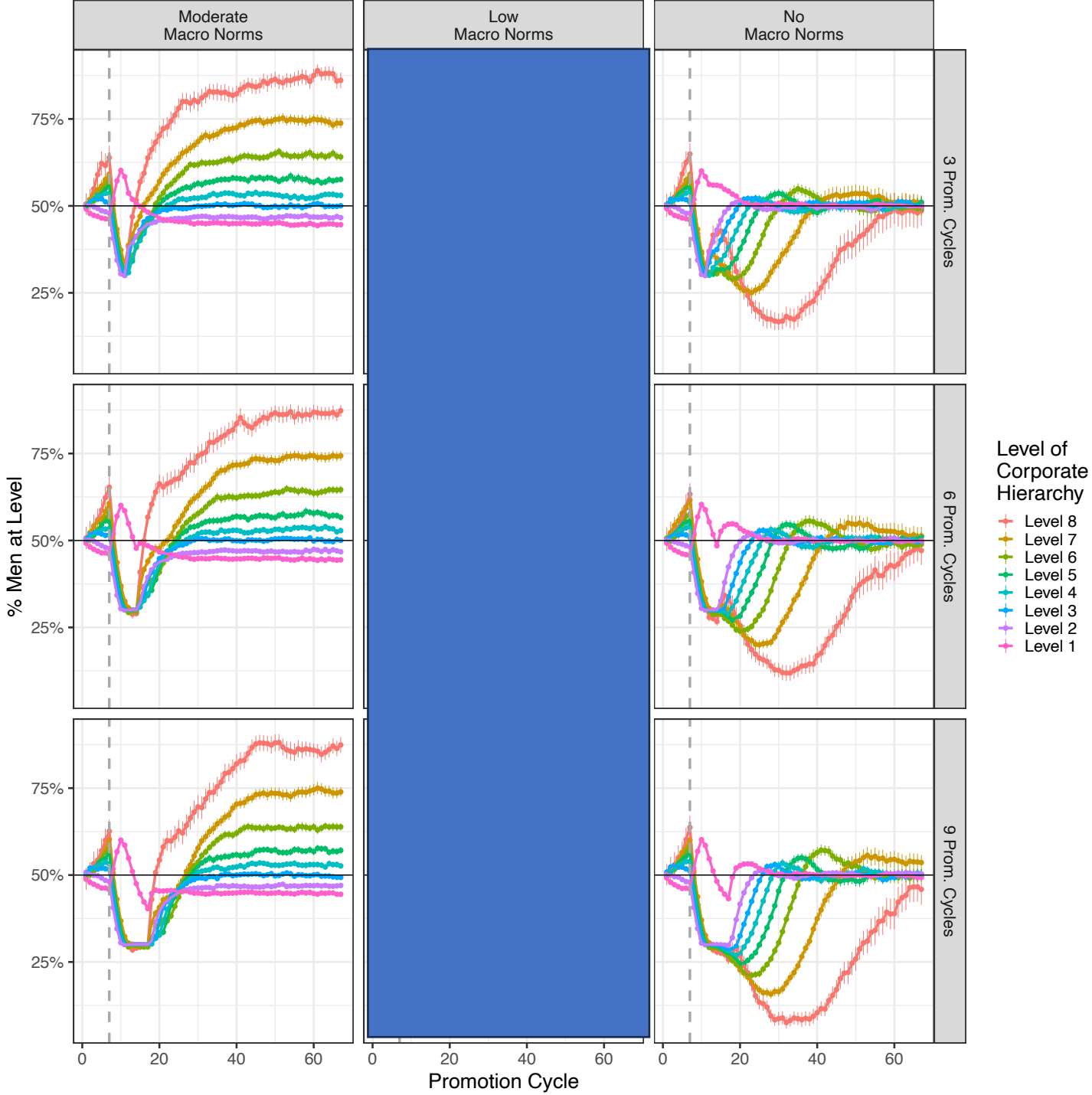
Act 4


Moderate Macro Norms
Low Macro Norms
No Macro Norms
3 Prom. Cycles
6 Prom. Cycles
9 Prom. Cycles
% Men at Level
75%
50%
25%
0
20
40
60
Promotion Cycle
Level of Corporate Hierarchy
Level 8
Level 7
Level 6
Level 5
Level 4
Level 3
Level 2
Level 1

Act 4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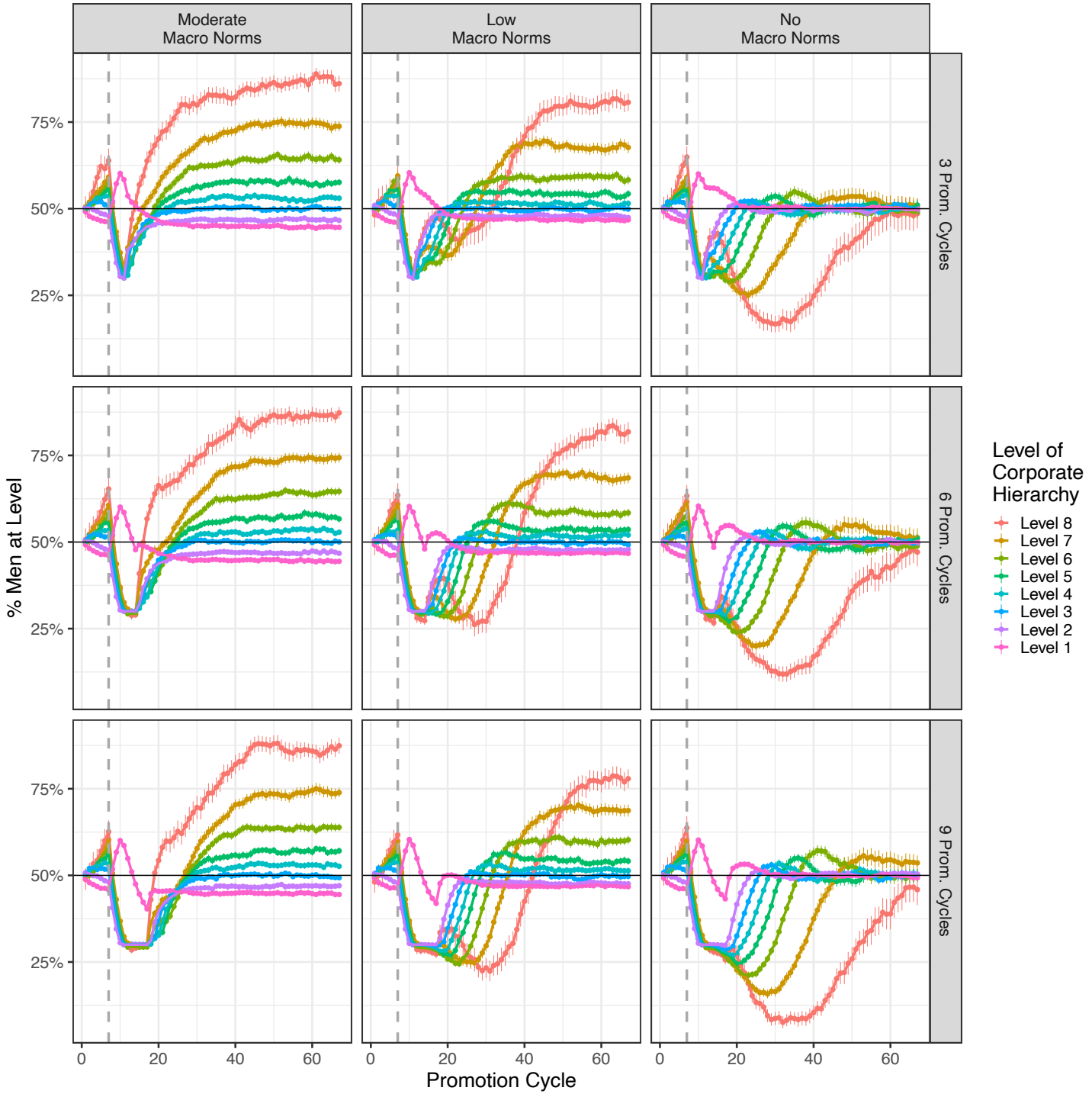
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Promotion Cycle
Level of Corporate Hierarchy
Level 8
Level 7
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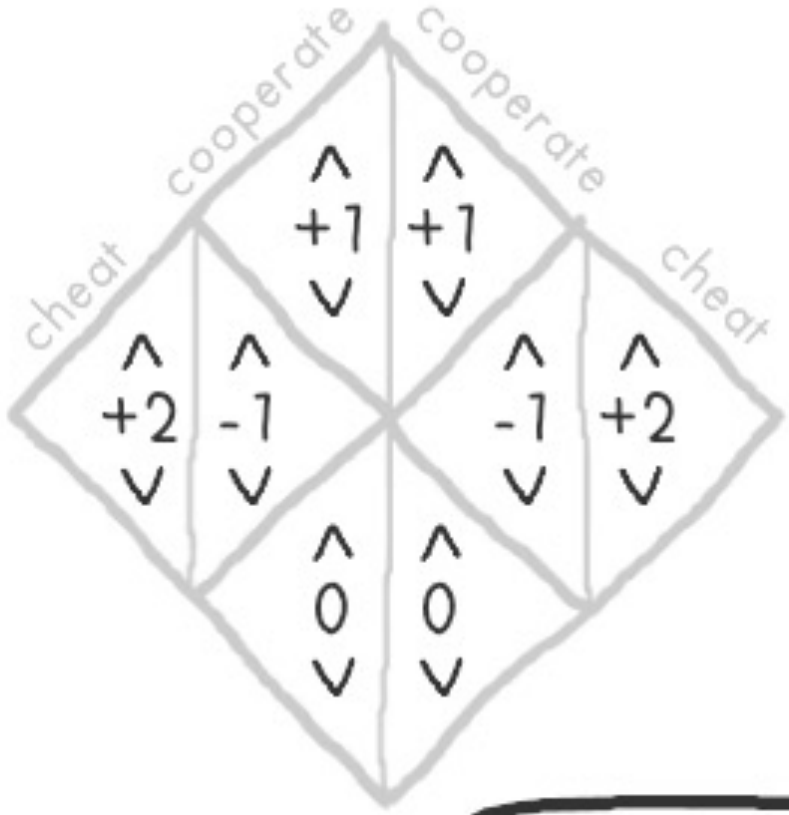
Level 1

Summary

- Small acts of discrimination **pile up** over time
- These acts of discrimination are influenced by social norms, which themselves are a function of norms both inside and outside the company
- Simulation can be useful!

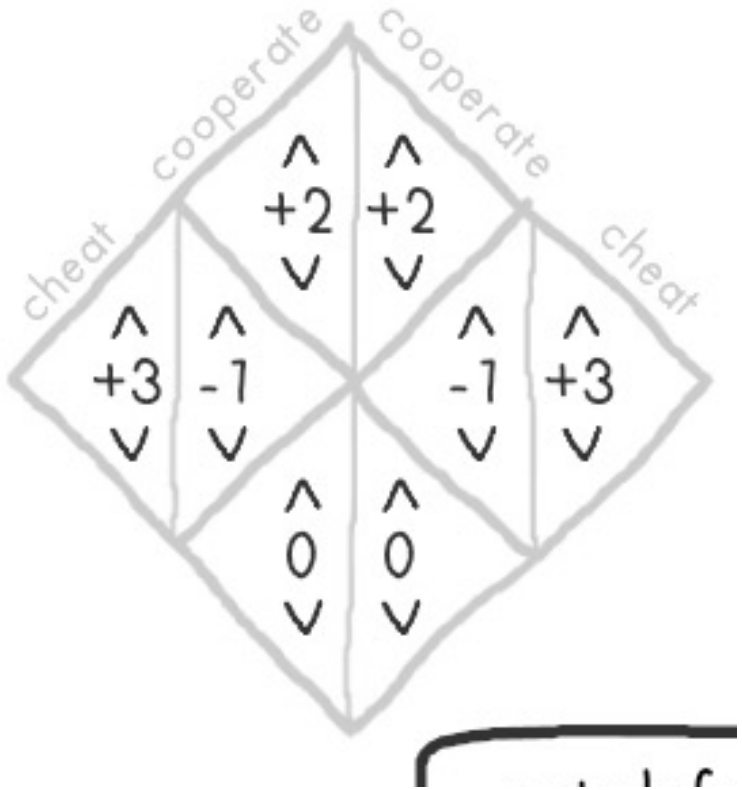
Prisoners Dilemma

The payoffs in a one-on-one game are:



PD - Questions

- The payoff matrix is a **parameter**
  - Create a payoff matrix where no one will ever cheat [**Rules matter!]**
  - Taking the payoff matrix on the left
    - What is the best move for **one game**? Can you prove it?
    - What is the best move for **multiple games**? … simulate



https://ncase.me/trust/

PD - Summary

- Sometimes we can combine theory and simulation depending on our parameter assumptions
- History is important!
- Rules/policy are important!
- Individual decision-making also matters

Your turn: explain your own model/VE

- https://www.complexity-explorables.org/explorables/
- Pick a model
  - How does the model work? ELI5
  - What are the parameters?
  - Identify an outcome, tell us how it changes with the parameters
  - What does this model tell us about some real-world social process?
  - What don't you like about this model?
  - **Bonus**: Can you come up with a fun VE?