

# Birds of a Feather Flock Together

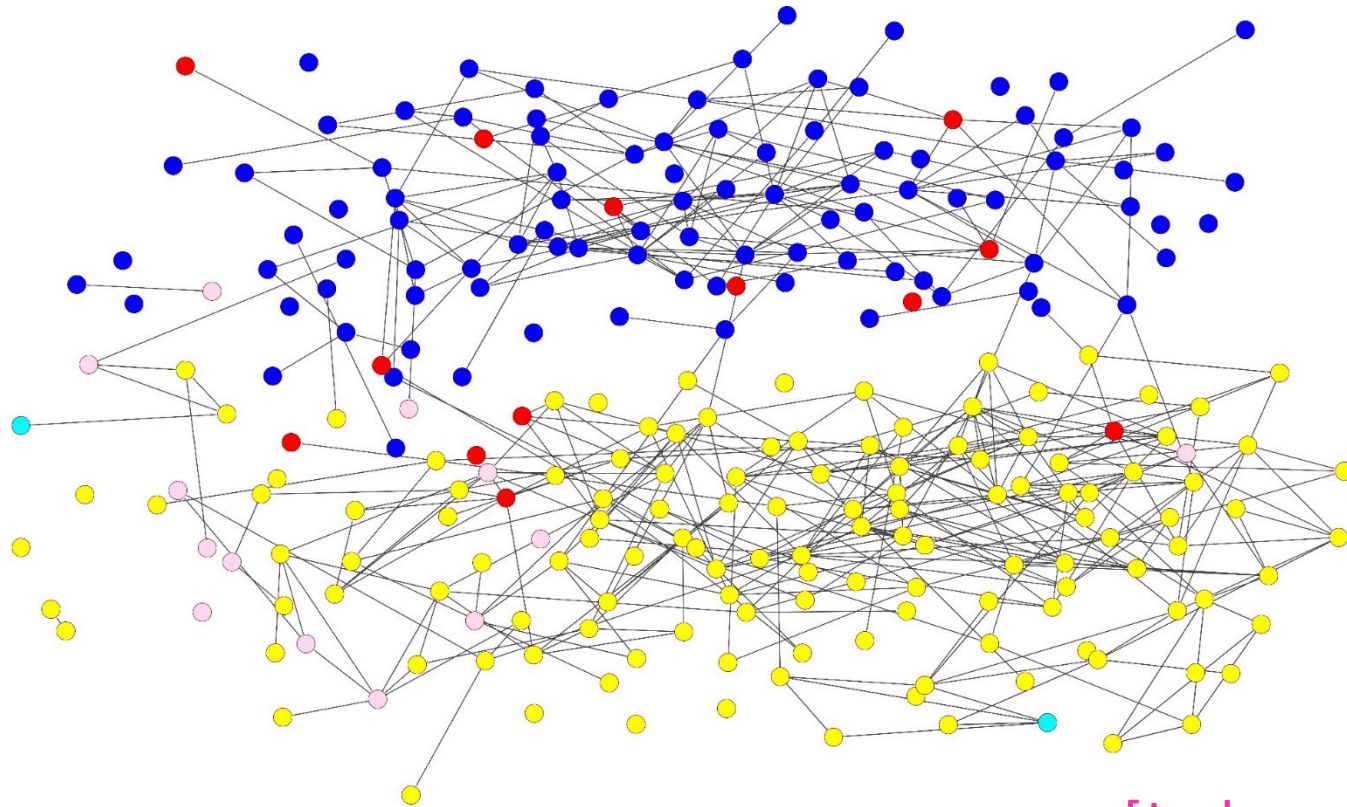
*How Homophily Leads to Segregation, Inequality and Inefficiency and what we can do about it.*

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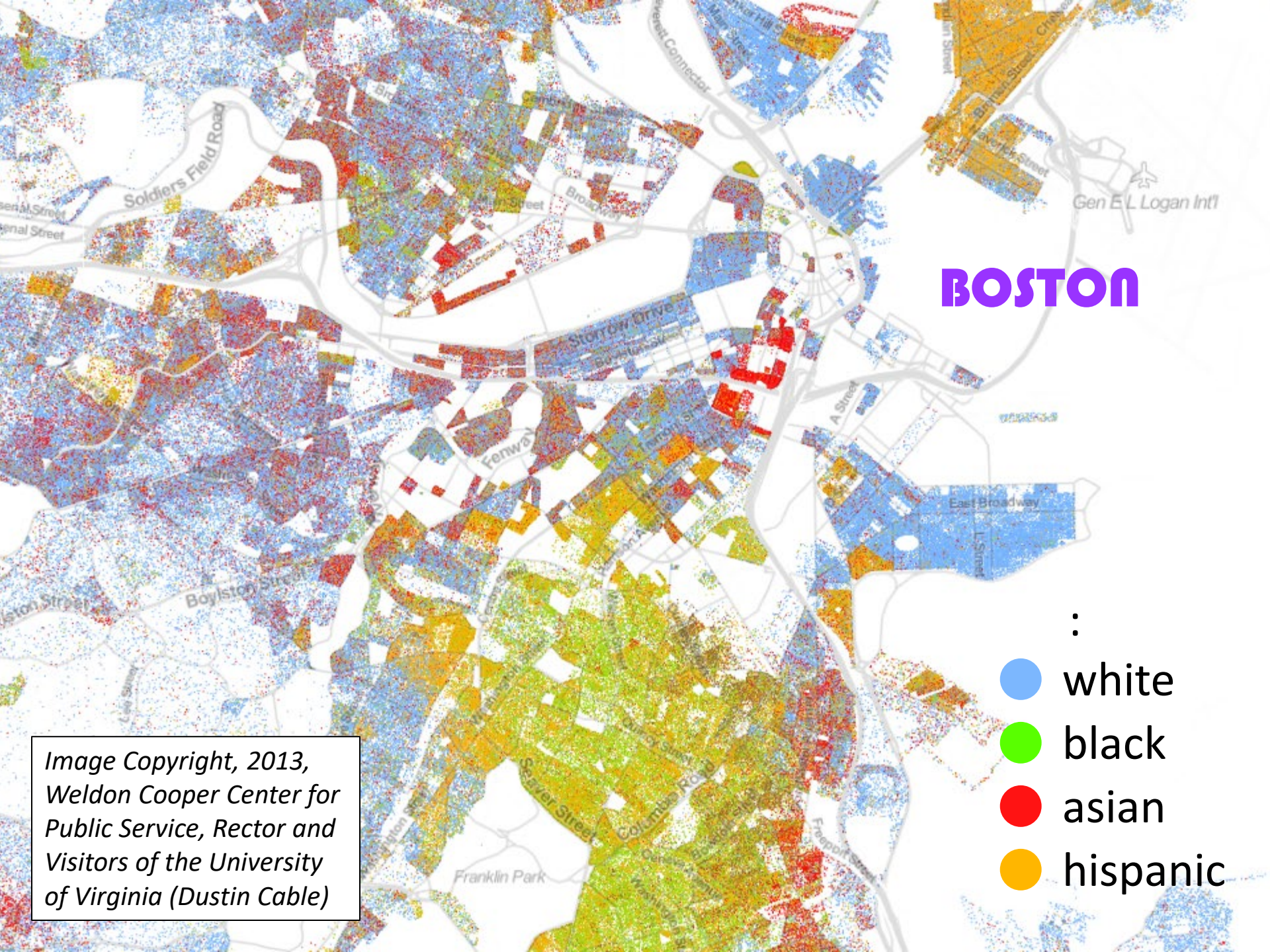
NICOLE IMMORLICA, MICROSOFT RESEARCH

# homophily.

People seek relationships with similar types.



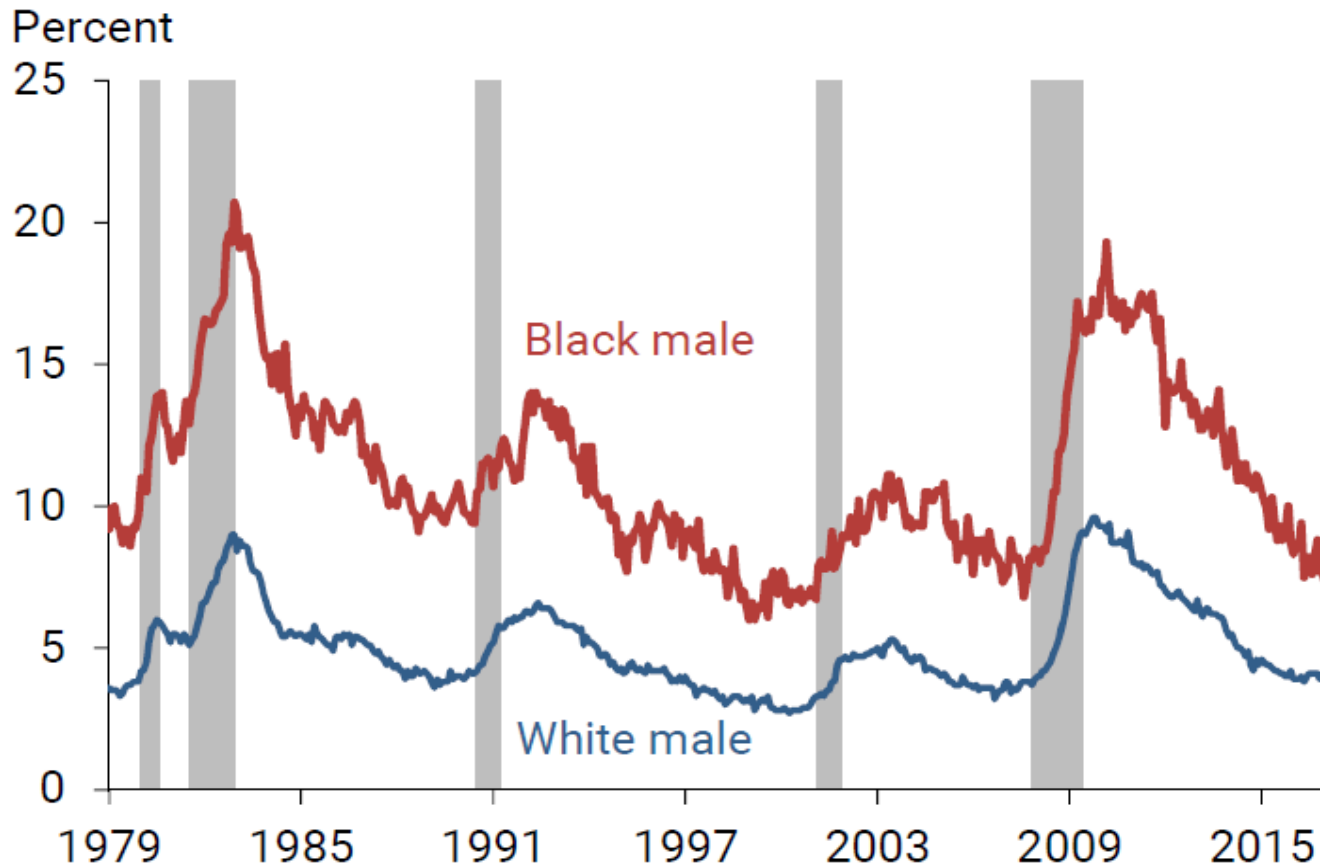
[Jackson, 2020]



*Image Copyright, 2013,  
Weldon Cooper Center for  
Public Service, Rector and  
Visitors of the University  
of Virginia (Dustin Cable)*

# inequality and immobility.

## A. Unemployment rates for men



[US Bureau of Labor Statistics]

# outline.

Exposition.

... Evidence of homophily and its effects.

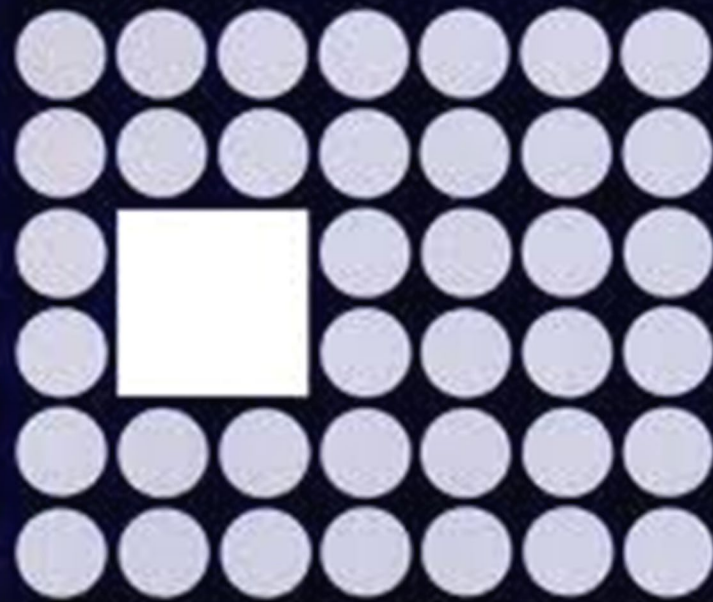
Episode.

... Homophily and Housing Markets.

... Homophily and Labor Markets.

Coda (if time).

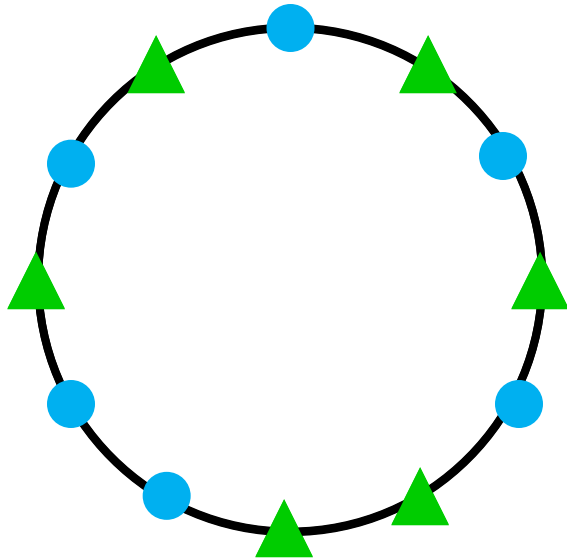
... Rational explanations for homophily.



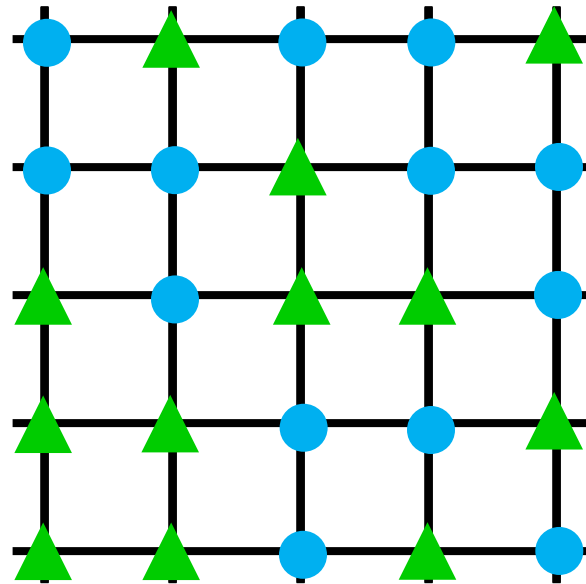
**Micromotives  
and  
Macrobehavior**

Thomas C. Schelling

model.

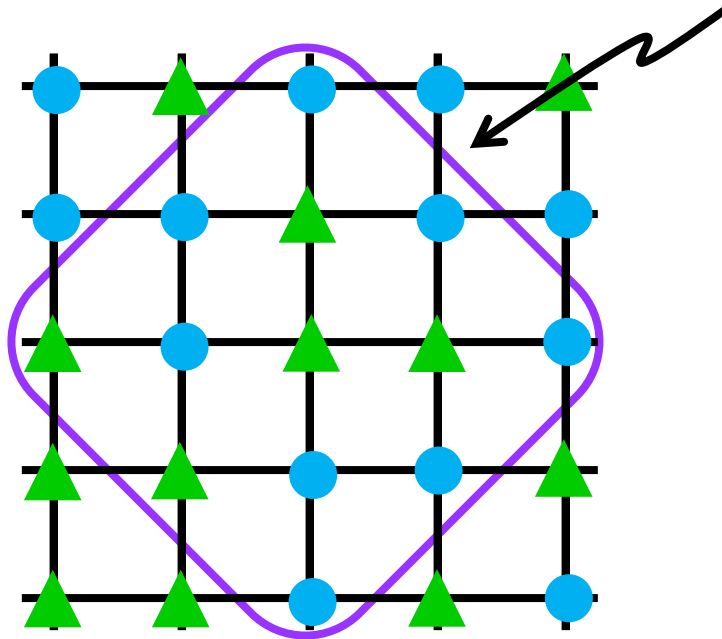


one-dimensional



two-dimensional

# individual preferences.



neighborhood of ▲ = people living within distance  $w$

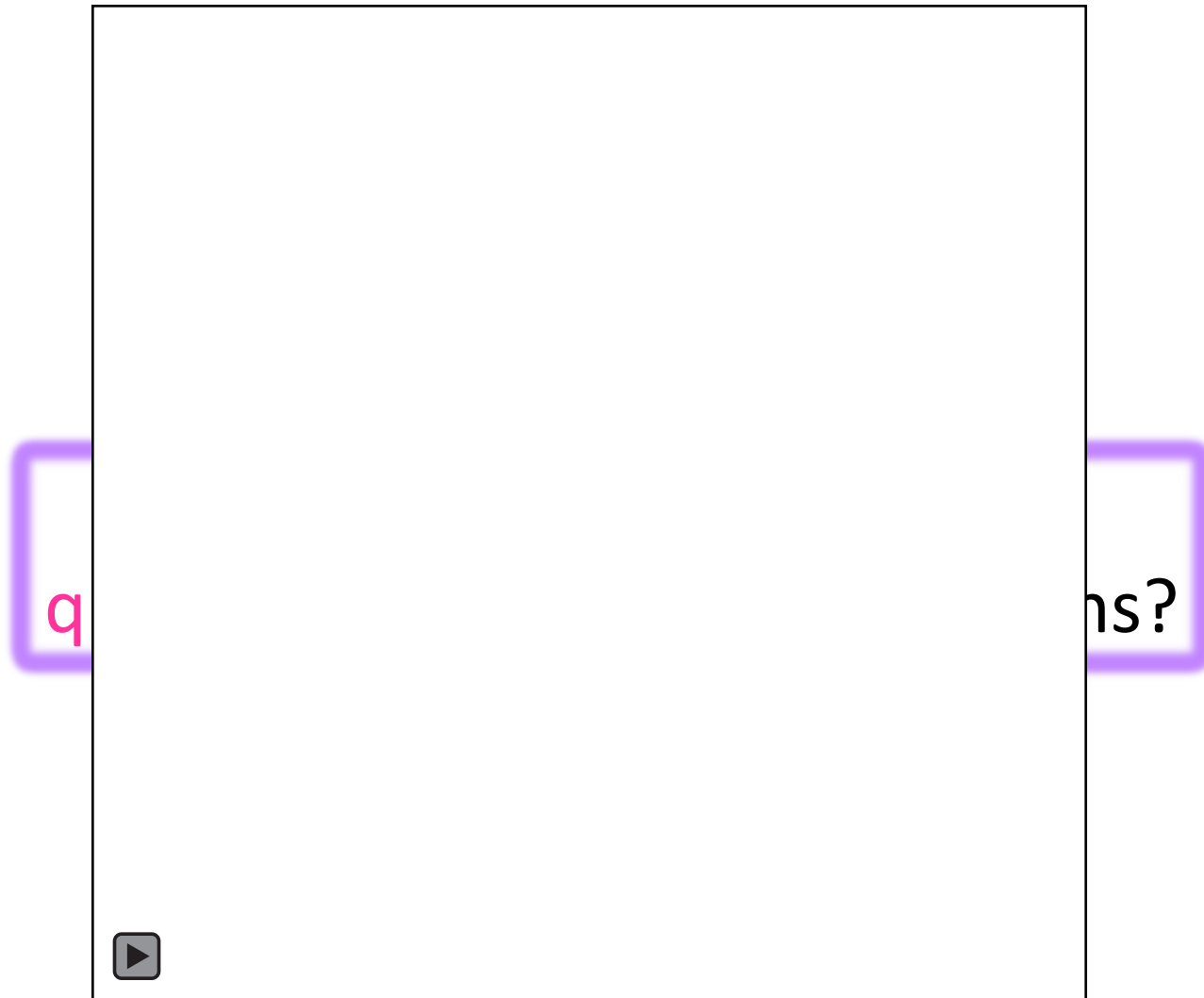
happy if at least  $\tau$  fraction of neighbors of like-type

move (by swapping or flipping color) if unhappy

important parameters:

- neighborhood size  $w$
- society size  $n$
- tolerance  $\tau$





Society of  $n = 750$  people, neighborhoods of size  $w = 5$ , tolerance of  $\tau = 0.5$  (people just don't like to be a minority).

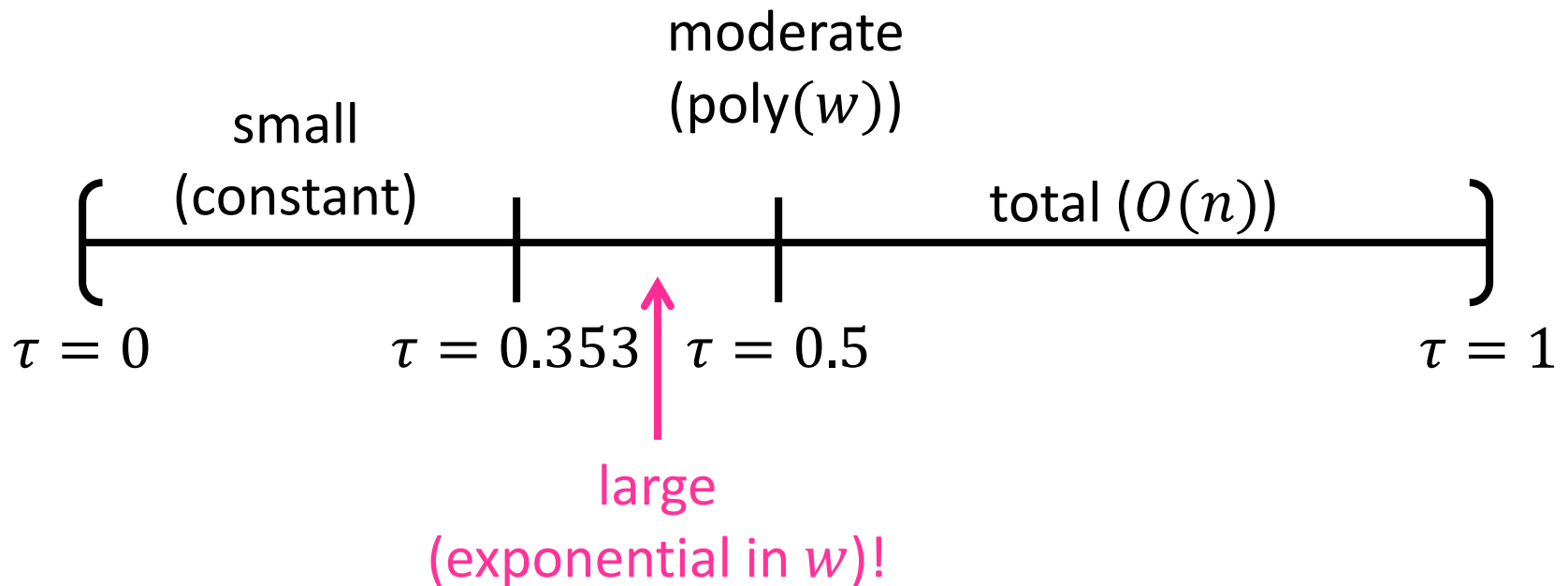
# one-dimensional.

Integration. Critical tolerance  $\tau = 0.5$  causes segregated neighborhoods distributed throughout the city in an integrated pattern.

- **why**: individuals move frequently to neighborhoods where they're a majority.
- **how**: neighborhoods with slight imbalance tip, becoming immune to immigration.

[Brandt, Immorlica, Kamath, Kleinberg, 2012]

# one-dimensional.



[Barmpalias, Elwes, Lewis-Pye, 2014]

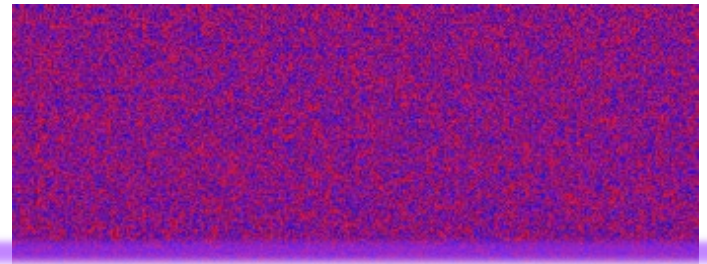
# two-dimensional.

Segregation. Sub-critical tolerance increases degree of segregation exponentially.

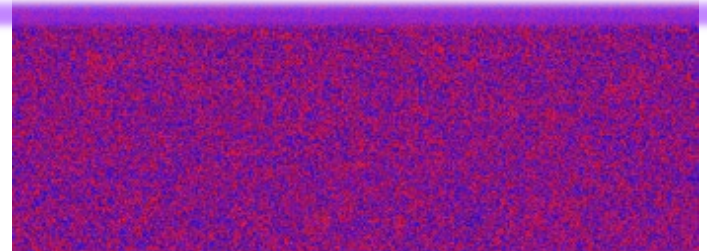
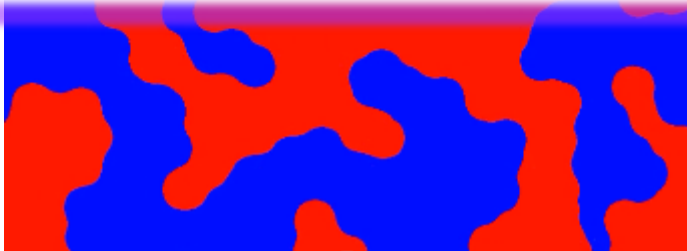
- **why**: waves of immigration wipe out initially complacent mixed neighborhoods.
- **how**: neighborhoods that are imbalanced enough to spread are exponentially rare.

[Immorlica, Kleinberg, Lucier, Zadimoghaddam, 2017]

# segregation.



Measure of segregation: The radius of the largest monochromatic region containing a (random) node.

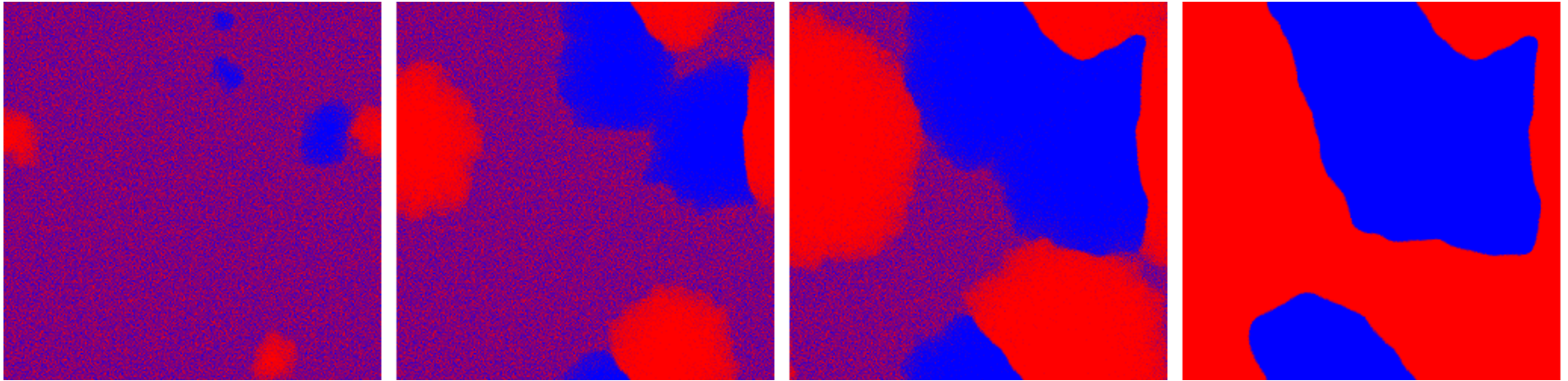


Critical tolerance:  $\tau = 0.5$

Fully tolerant:  $\tau = 0$

simulation.

Sub-critical tolerance:  $\tau = 0.36$



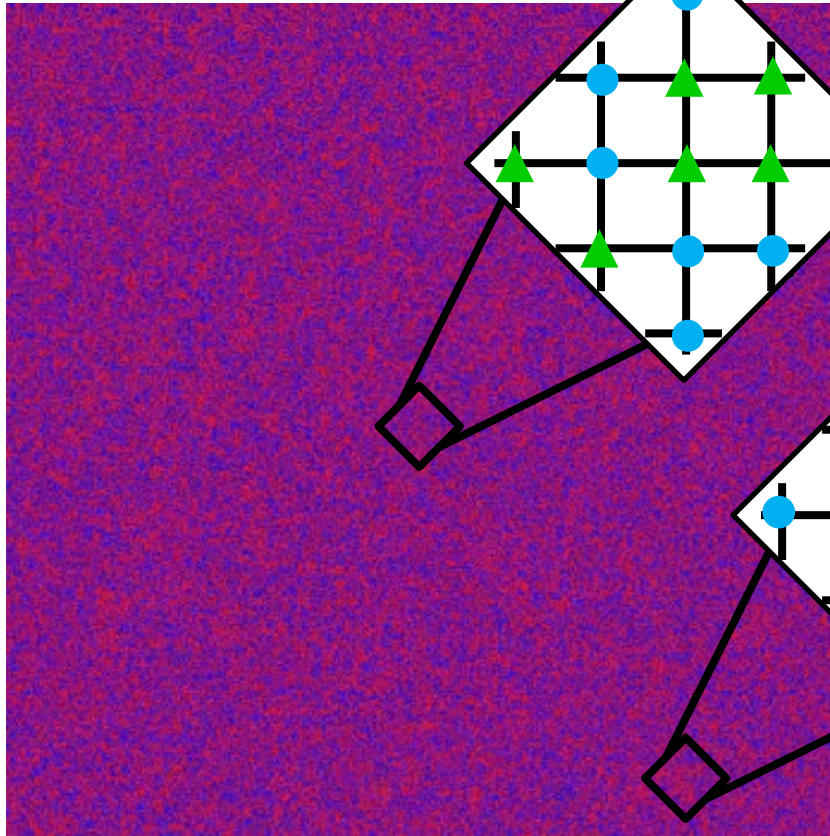
# societal segregation.

**Theorem.** Fix  $w$ , take  $n$  sufficiently large, and  $\tau = 0.5 - \epsilon$  for sufficiently small  $\epsilon$ . Then the expected radius of the monochromatic region of a random node is  $> e^{c\epsilon^2 w^2}$  for a constant  $c$ .

[Immorlica, Kleinberg, Lucier, Zadimoghaddam, 2017]

rationale.

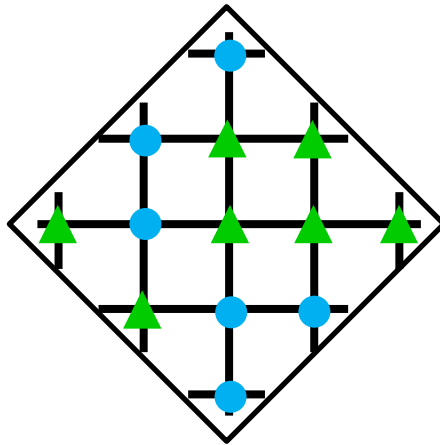
Most neighborhoods look like this, approximately 50% of each type.



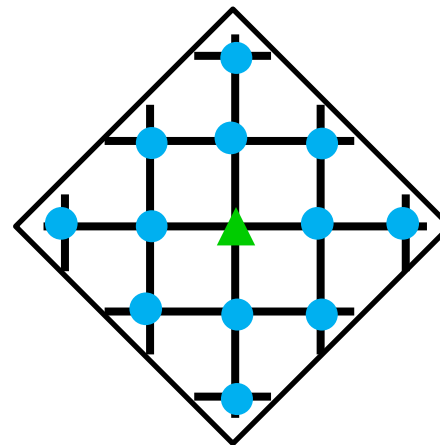
A few (exponentially rare) neighborhoods look like this, almost monochromatic.



rationale.

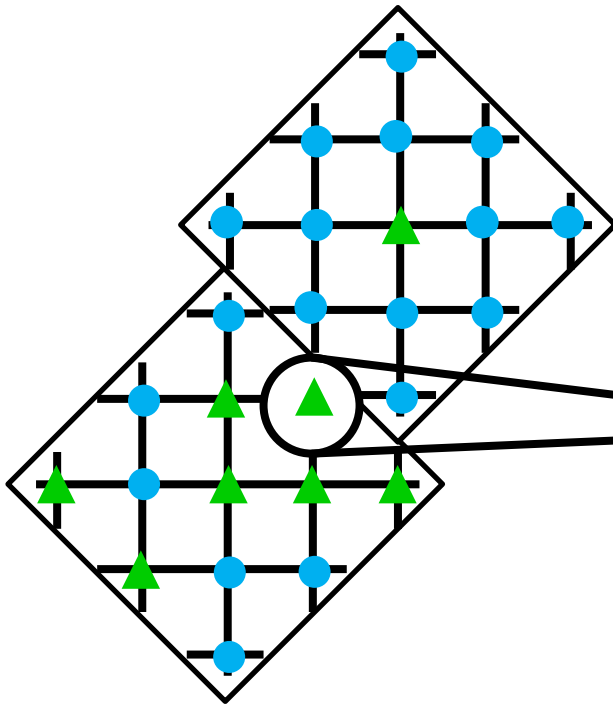


complacent

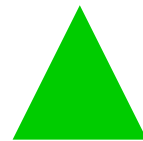


agitated

rationale.



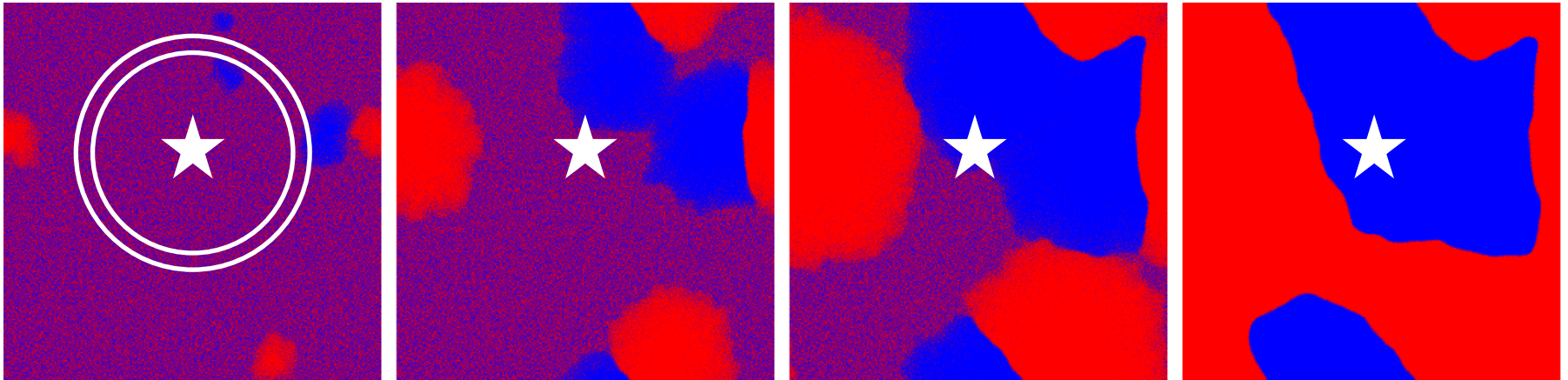
agitated



NE neighbors 100% ●,  
SW neighbors 50% ●,  
= 75% neighbors ●!

complacent

rationale.



- Agitated neighborhoods initiate waves of immigration,
- Stopped only by opposite-color agitated neighborhoods,
- These are exponentially far apart.

# recap.

Weak preferences for homophily can cause drastic geographical segregation in housing markets.

Developing policies to address segregation requires understanding the mechanisms by which it spreads.

**Mechanism:** homogenous neighborhoods infiltrate integrated ones, creating a wave of immigration

**Policy:** subsidize housing in integrated neighborhoods?

# outline.

Exposition.

... Evidence of homophily and its effects.

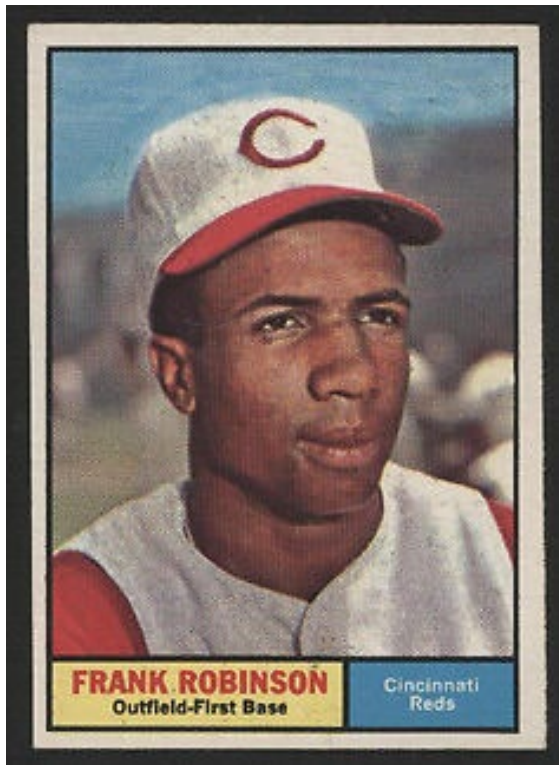
Episode.

... Homophily and Housing Markets.

... Homophily and Labor Markets.

Coda (if time).

... Rational explanations for homophily.



“I’ve never seen baseball advertise for a job, and I’ve never heard of whites applying for a job.

I mean, there’s an old boy network, and it’s **lily white**.”

# referral networks.

Referrals are important for getting jobs.

... over 50% of jobs are found through referrals at all skill levels [Topa, 2011]

... marginal effect of an additional peer gaining employment increases a veteran's likelihood of employment by 0.8% [Laschever, 2013]

# impact of referrals.

## Inequality.

... workers with referrals are advantaged.

## Immobility.

... employed groups benefit across generations.

## Productivity.

... vetting workers improves matches.

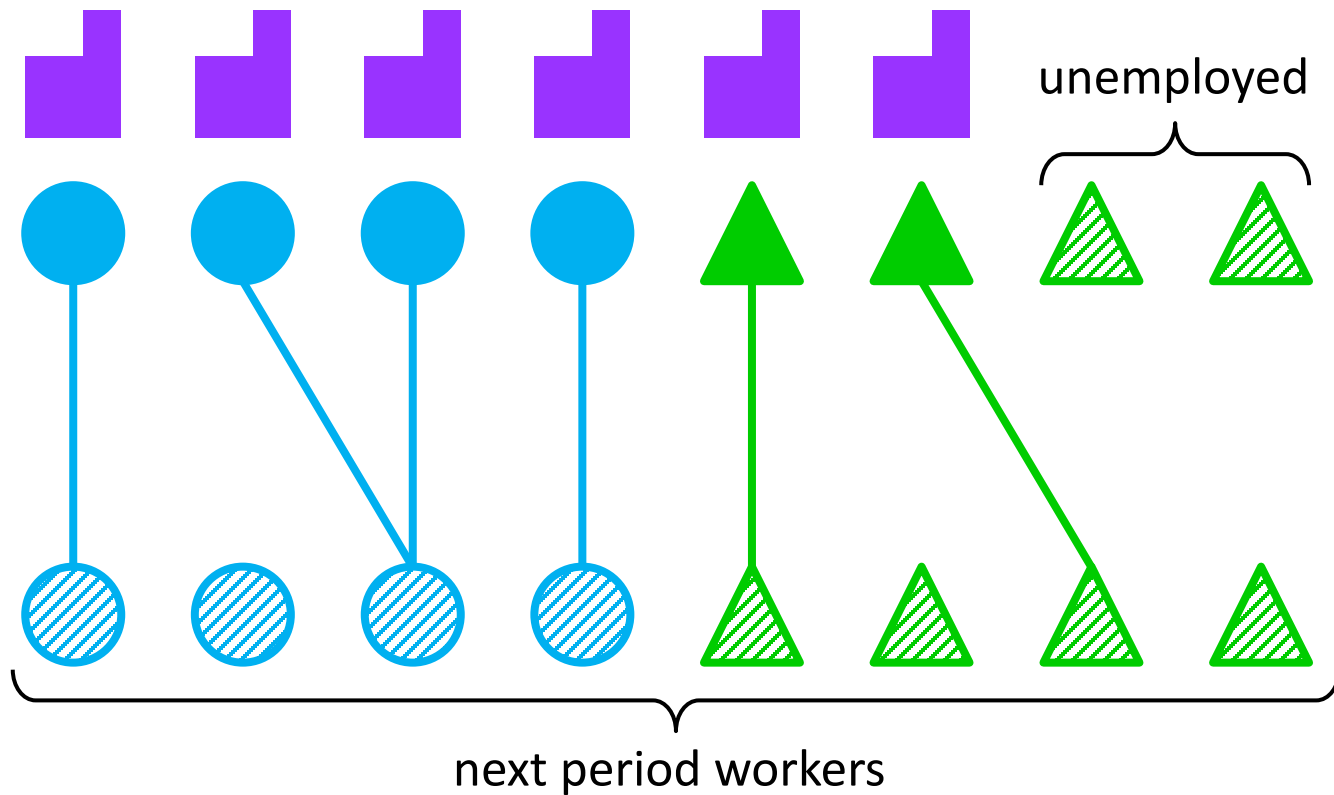


# model.

Firms: 

Workers:   
Values:  $v_1$   $v_2$   $v_i \sim F$

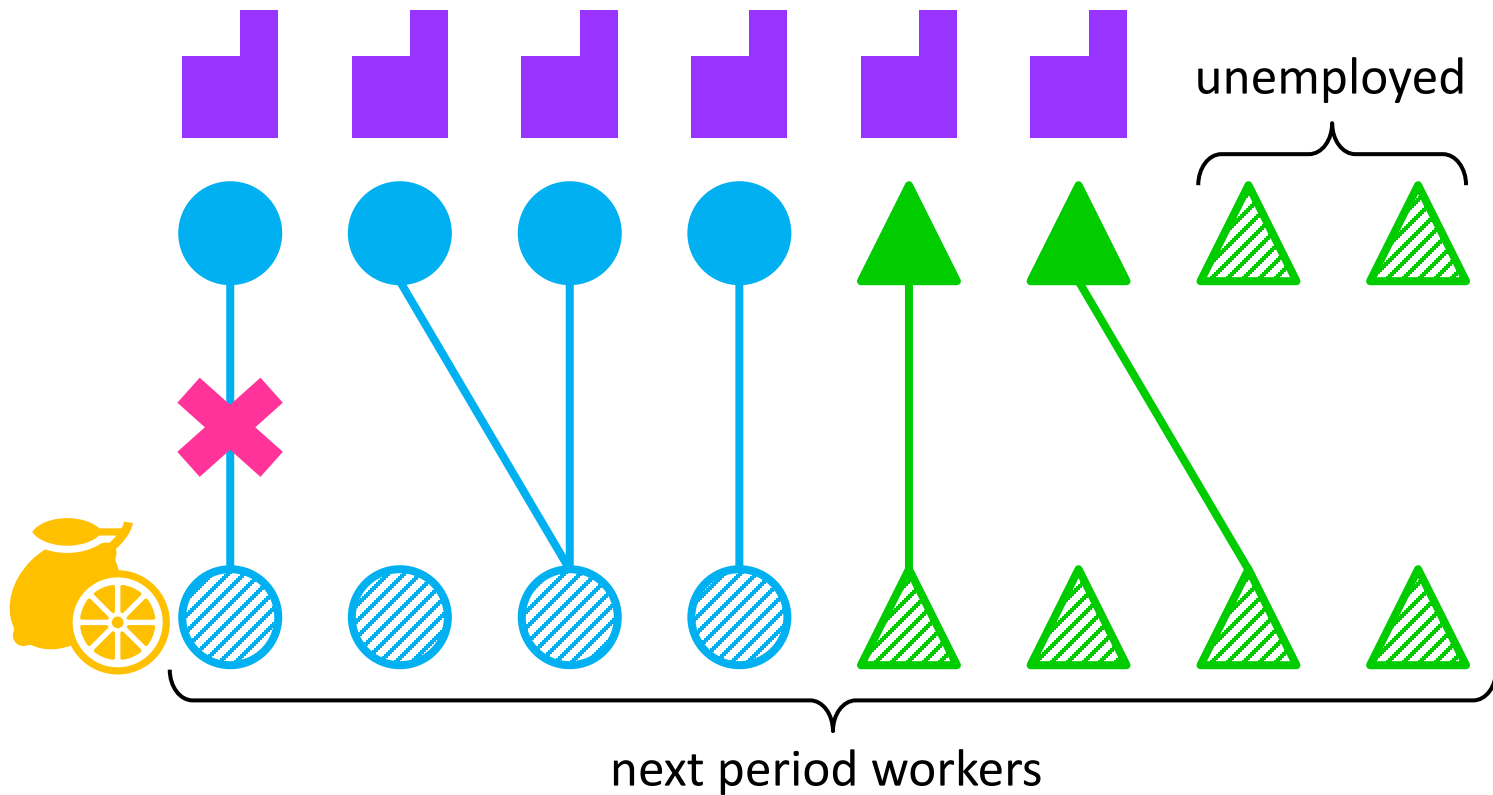
model.



**Hire:** referred worker, or random worker from pool of unemployed.

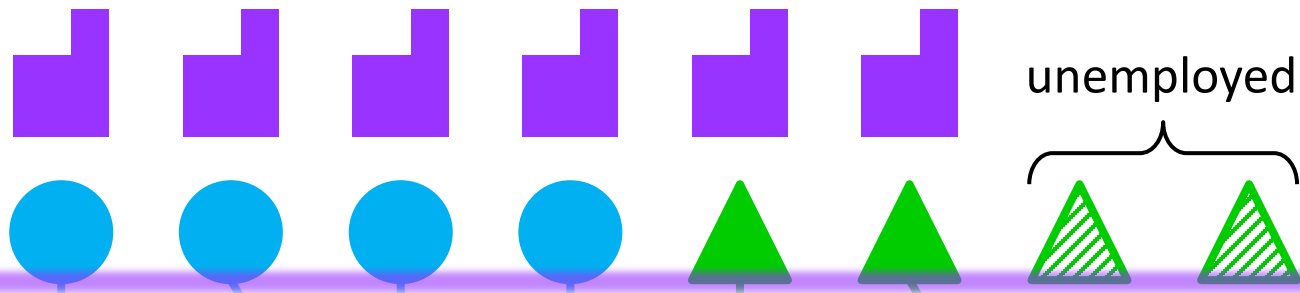
**screening effect:** see value before making offer

# lemons' effect.

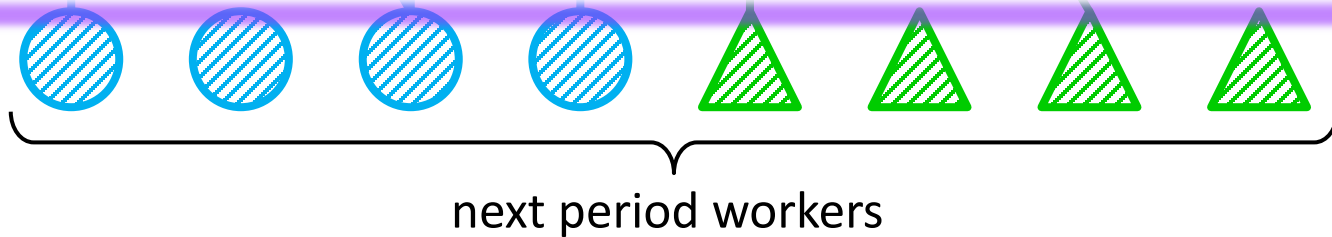


Average value of unemployed workers (in the pool) is smaller than average value of workers in population overall.

# equilibrium.

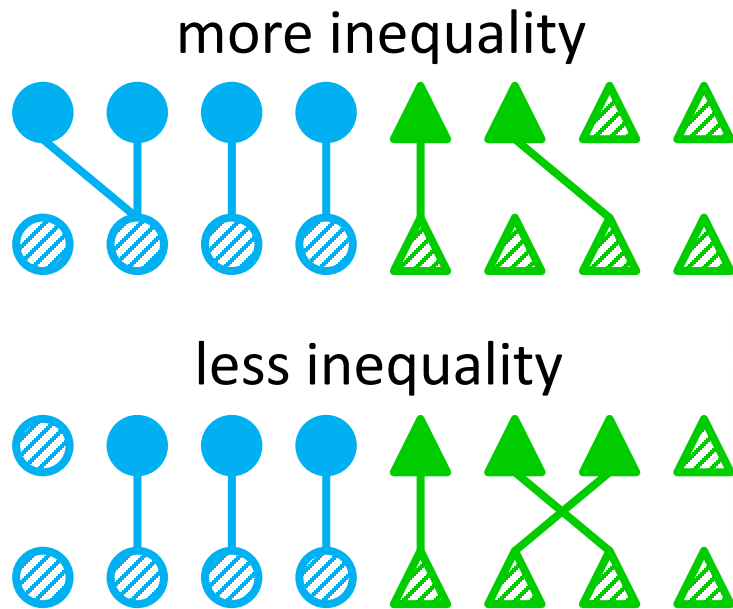


**Inequality and Immobility:** Referred workers get more offers on average, so more likely to be hired and with higher wages, perpetuating inequality.\*



Firms try to hire referred worker  $i$  if  $v_i \geq v^* = E[v(\text{unemployed})]$ ;  
If fail to hire or  $v_i < v^*$ , then hire random unemployed worker.

# inequality and productivity.



networks with higher inequality have more concentrated referrals implying

- 👎 ... less screening;
- 👍 ... but also less lemons.

**Theorem.** Employment ratios that are closer to being population-balanced strictly improve productivity.

[Bolte, Immorlica, Jackson, 2022]

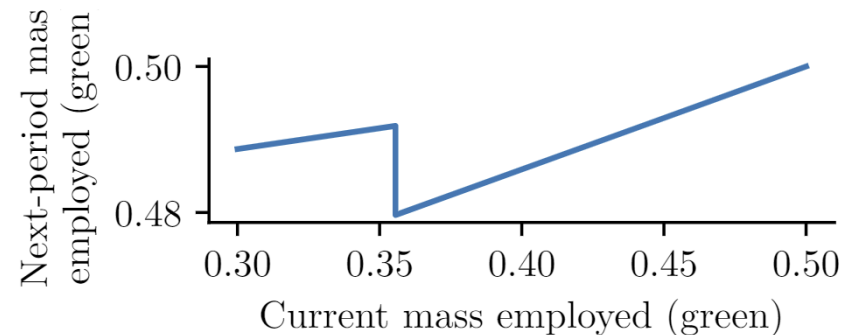
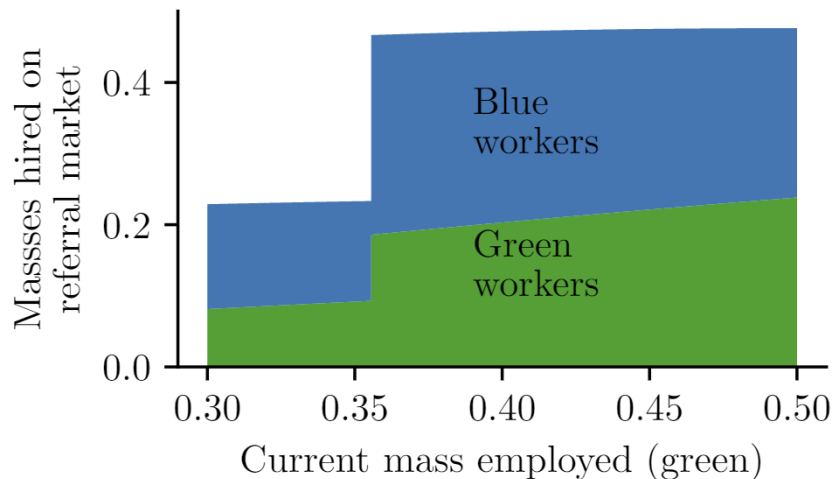
# affirmative action.

Increase green employment.

- ... set quotas on green hires
- ... subsidize green hires
- ... require firms to interview greens
- ... tax hiring blues

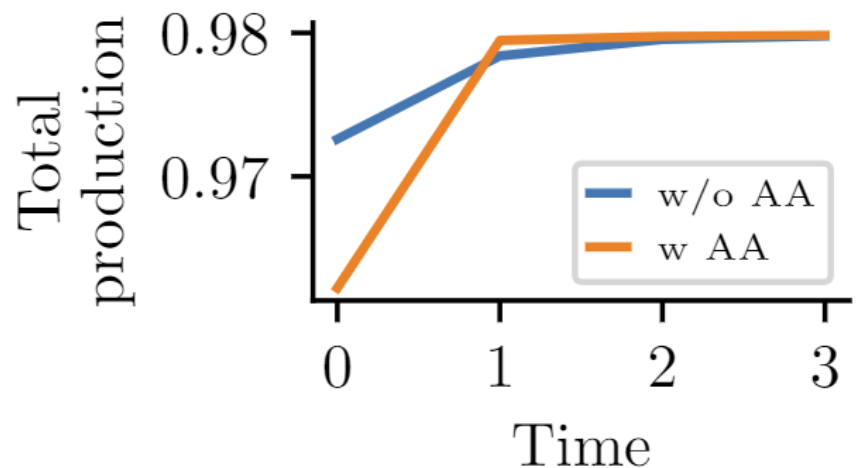
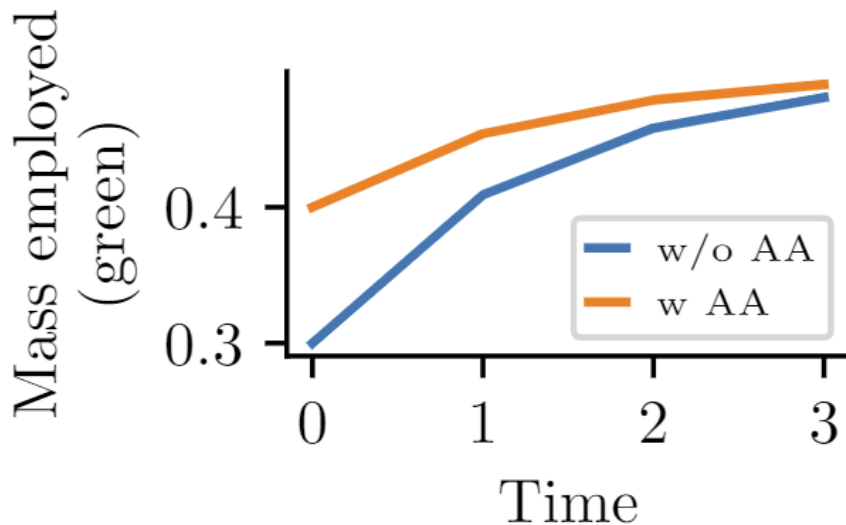
# long-run impact.

An arbitrary increase in current green employment may decrease future green employment, due to a shift in hiring from the referral market.



# long-run impact.

A modest increase in current green employment increases future green employment, and overall productivity, in all future periods.



[Bolte, Immorlica, Jackson, 2022]



## recap.

Homophily in referral networks can cause labor markets to perpetuate inequality (and reduce productivity).

Developing policies that address inequality in labor markets requires an understanding of the underlying mechanisms to eliminate persistence.

**Mechanism:** concentration in who gets referrals

**Policy:** affirmative action via, e.g., subsidized internships; more flexible firing policies

# outline.

Exposition.

... Evidence of homophily and its effects

Episode.

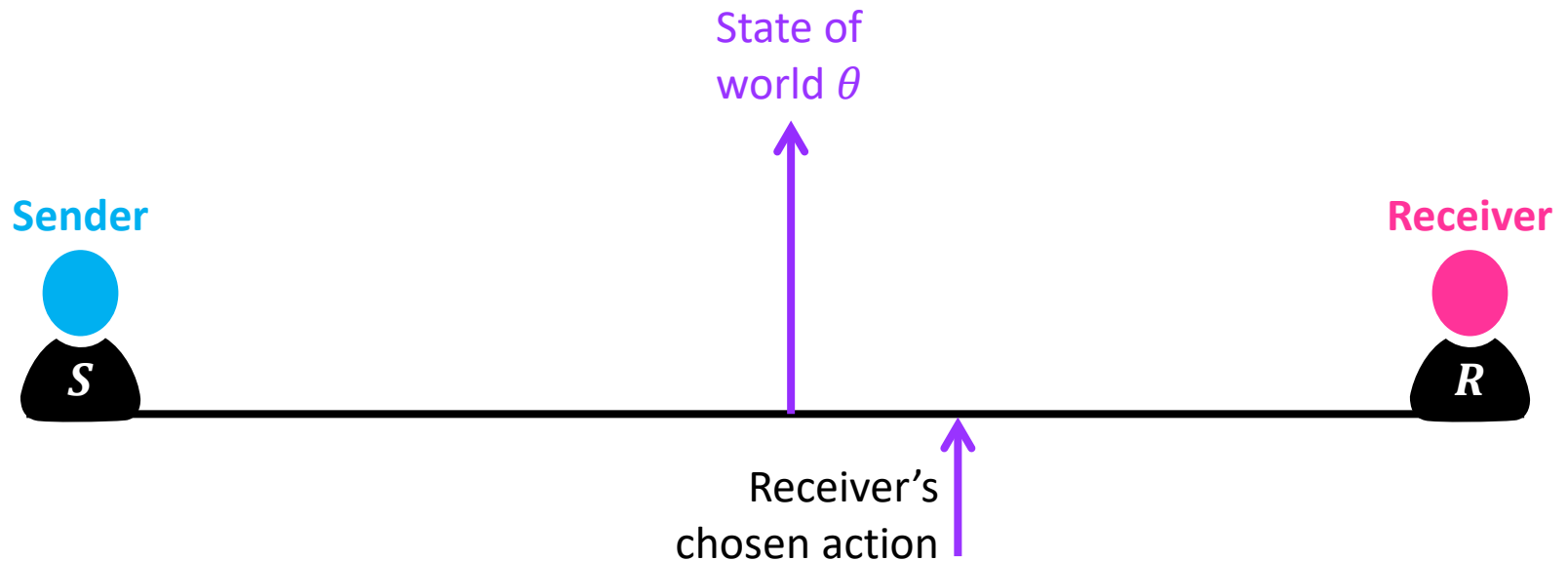
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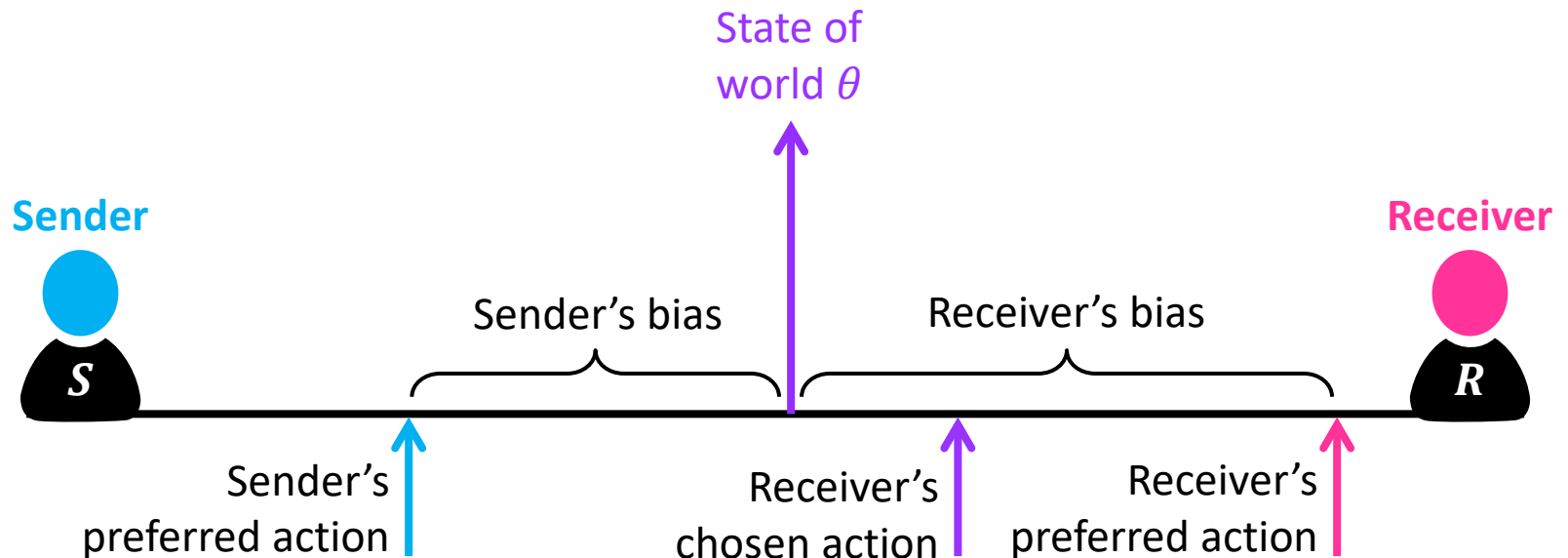
... Rational explanations for homophily.

# communication game.



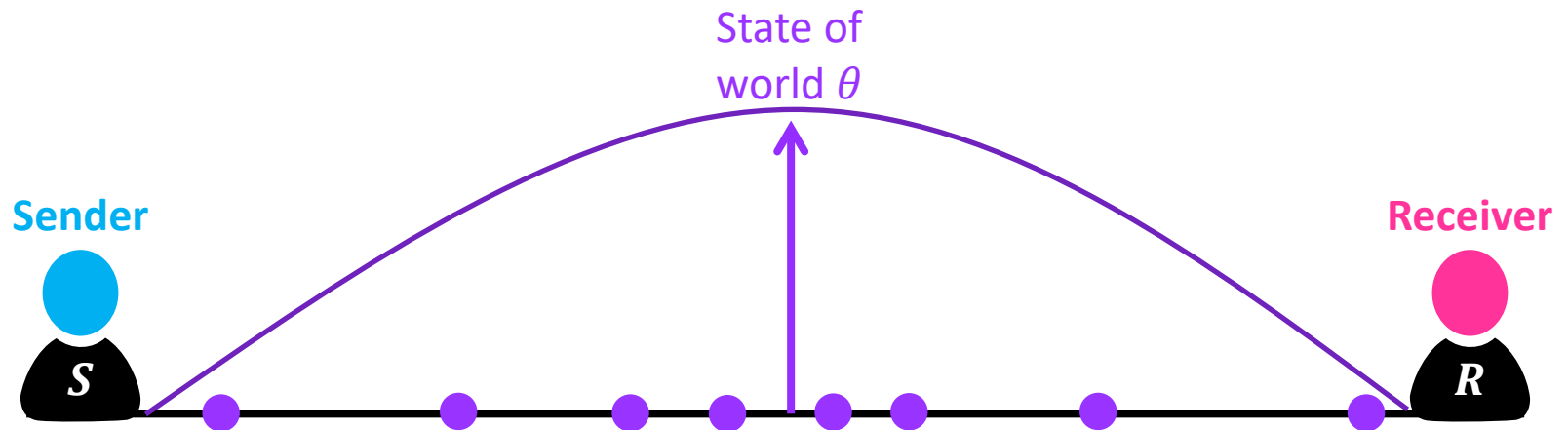
- Informed **sender** talks to an uninformed **receiver** about the **state of the world**.
- Receiver takes an **action** that the sender cares about.

# communication game.



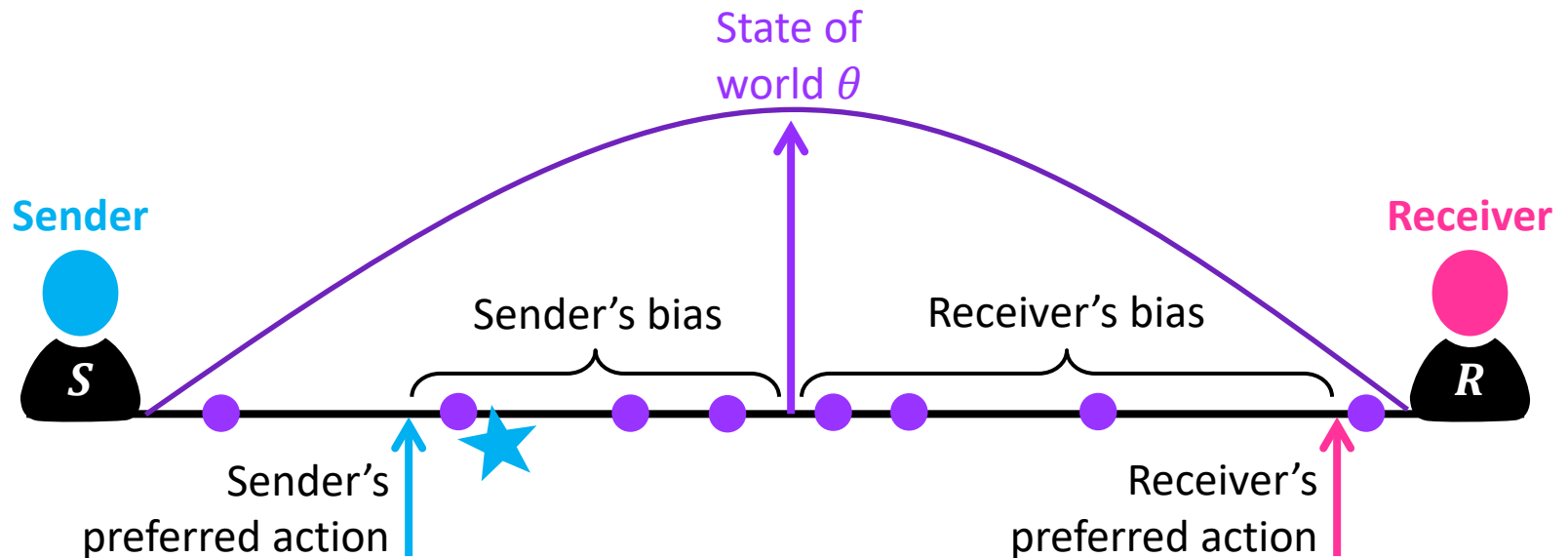
- While the sender and receiver both care about the state, they also have (potentially differing) personal preferences.

anecdotes.



True stories known to sender which she can choose to talk about (i.e., sender can **cherry-pick anecdotes**).

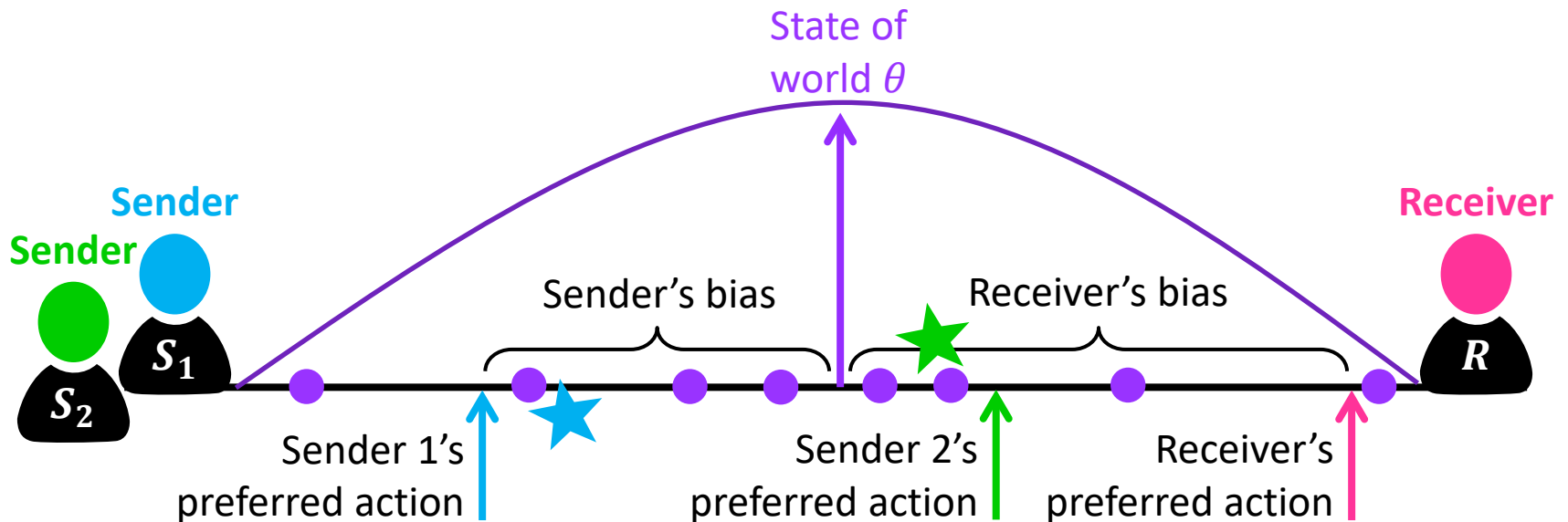
bias.



**Theorem.** The more misaligned the preferences, the more biased the communicated anecdote.

[Haghtalab, Immorlica, Lucier, Mobius, Mohan, 2022]

bias.



**Corollary.** Receivers may prefer more aligned senders as their anecdotes are less biased and hence less noisy.

[Haghtalab, Immorlica, Lucier, Mobius, Mohan, 2022]

# conclusion.

**Homophily exists:** Humans tend to seek out those more similar to them (and this may be rational).

**Homophily has profound impacts on society:**

... geographical segregation in housing markets

... inequality, immobility, inefficiency in labor markets

**Theoretical work** sheds light on the mechanisms at play and can be used to suggest **effective policies**.