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Fake News in Social Nets

how to observe, study, and contrast them

INTESA SANPAOLO
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AI LAB | ARTIFICIAL INTELLIGENCE | Iniziativa di INTESA SANPAOLO INNOVATION CENTER

Torino, March 24, 2020

http://www.di.unito.it/~ruffo/talks/2020_Mar_ISP.pdf
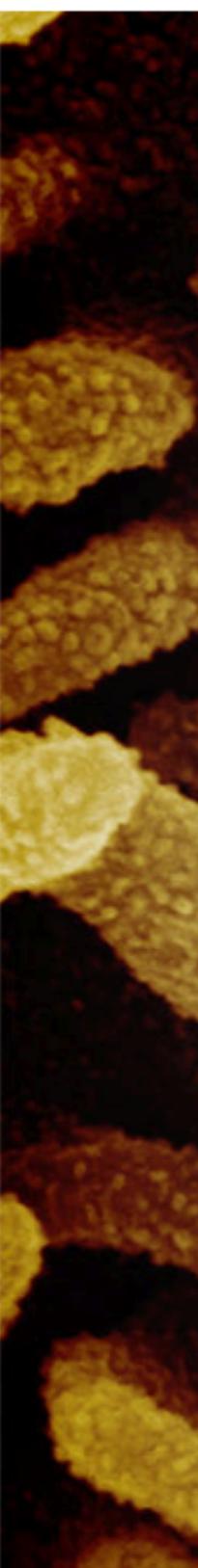
Coronavirus, Sharon Stone: "A Venezia cigni e delfini, una settimana al mese di smartworking sempre"

La star americana, che da giorni segue lo sviluppo della pandemia con particolare affetto nei confronti del nostro paese, fa una provocazione

Scie
theo

By Jon C

informazione pubblicitaria

What I do (and don't....)

- Academic and industrial research

- Data and network analysis

- Models of diffusion processes

- Social media and data as a resource
  - the interplay between 'segregation' and 'polarization'
  - rational motivations

- I don't debunk, I am not a journalist

- I don't look for automatic identification of true and false news

- I do not target social media as evil
  - I don't believe in censorship or freedom of speech limitations
  - I don't look for simple explanations to complex problems (e.g., gullible people is also stupid!)

Agenda
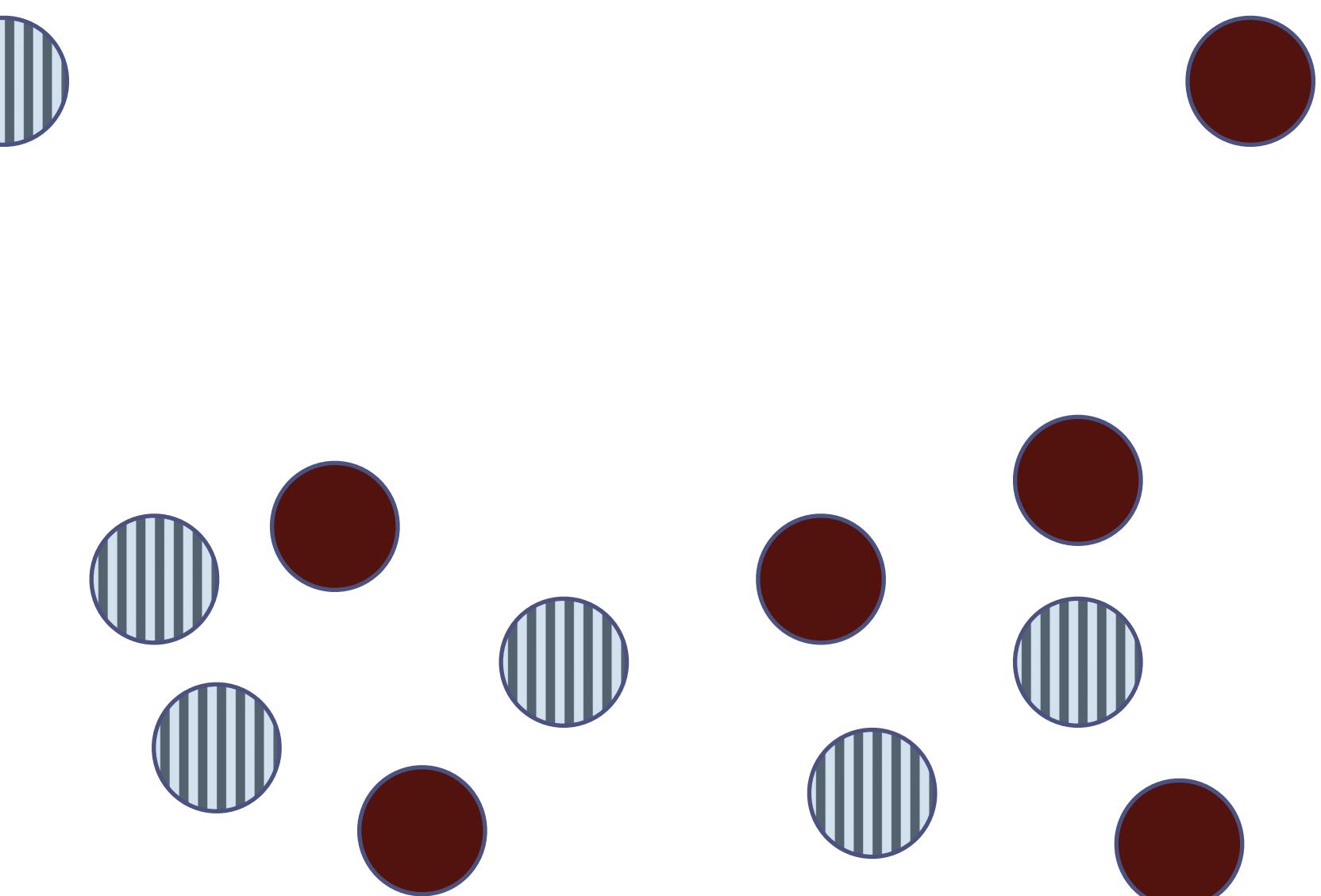
- Segregation and polarization

- Modeling **disinformation diffusion**

  - the role of **forgetting** and **news verification**

  - the role of **segregation**

 - evaluating debunking **strategies**

- Discussion and **conclusions**

Segregation and Polarization
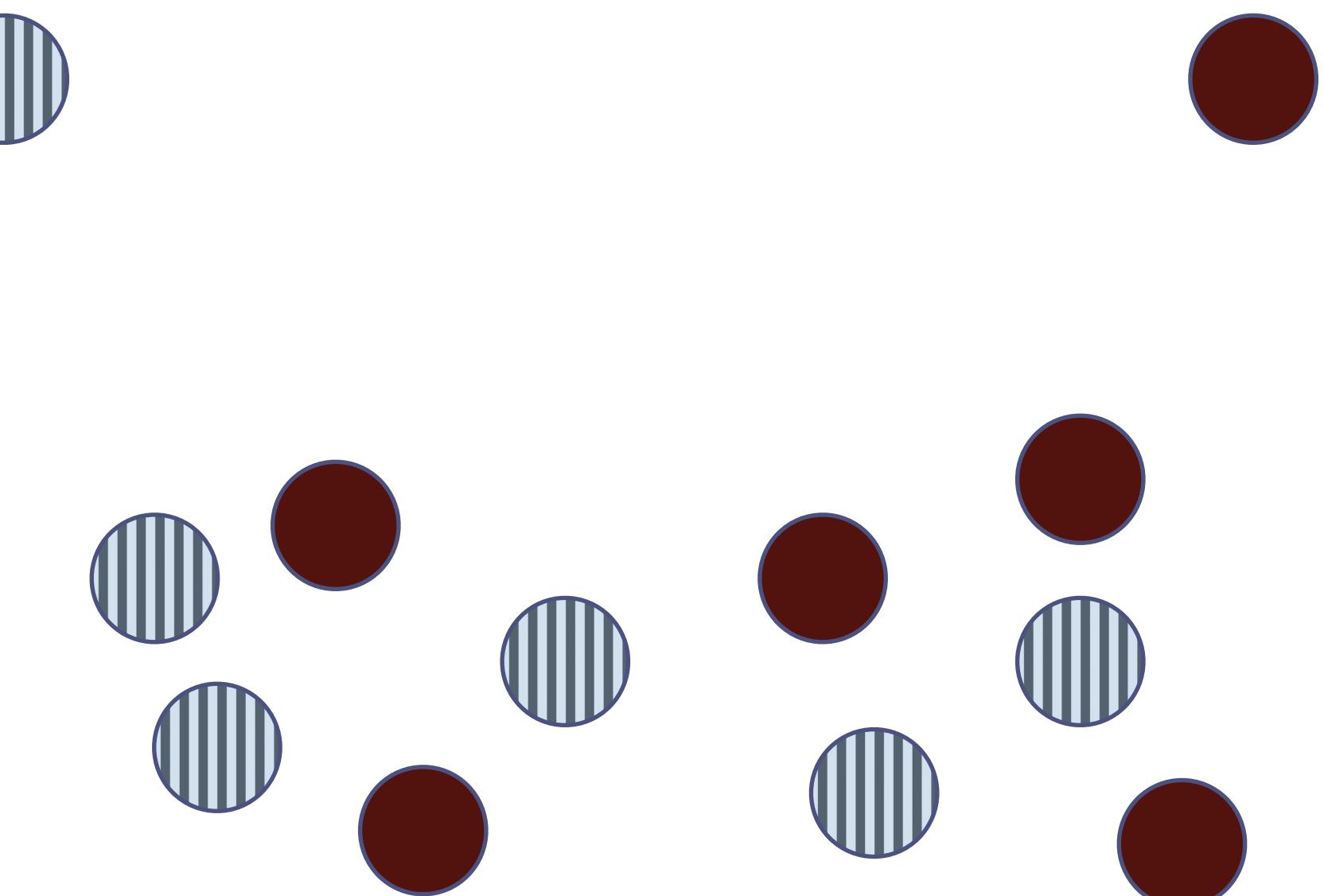
Segregation

- Society's structure is shaped in function of **immutable characteristics** of individuals

  - ethnic group

  - age

  - religious belief

  - …

Segregation

- Society's structure is shaped in function of **immutable characteristics** of individuals

  - ethnic group

  - age
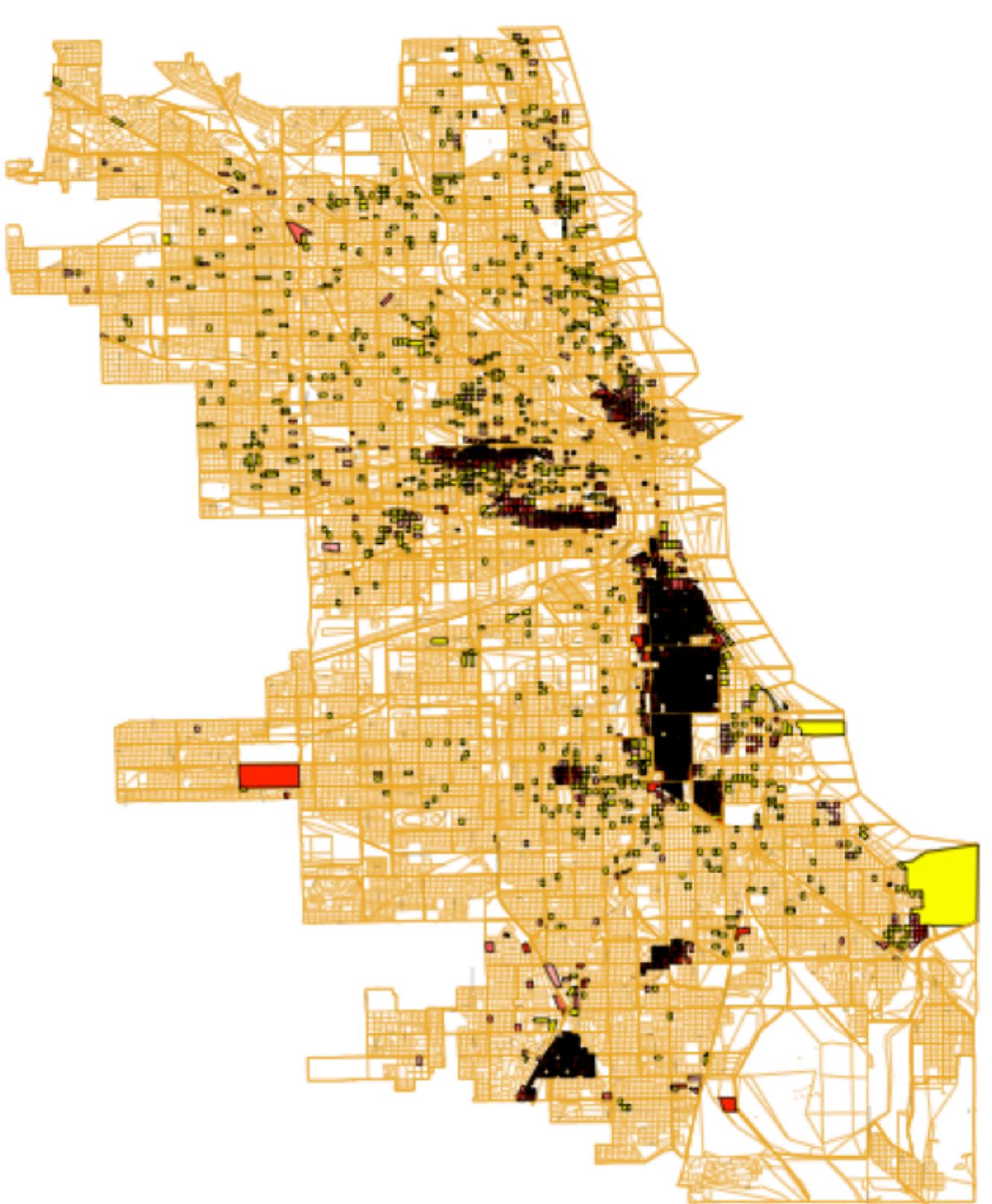
 - religious belief

  - …
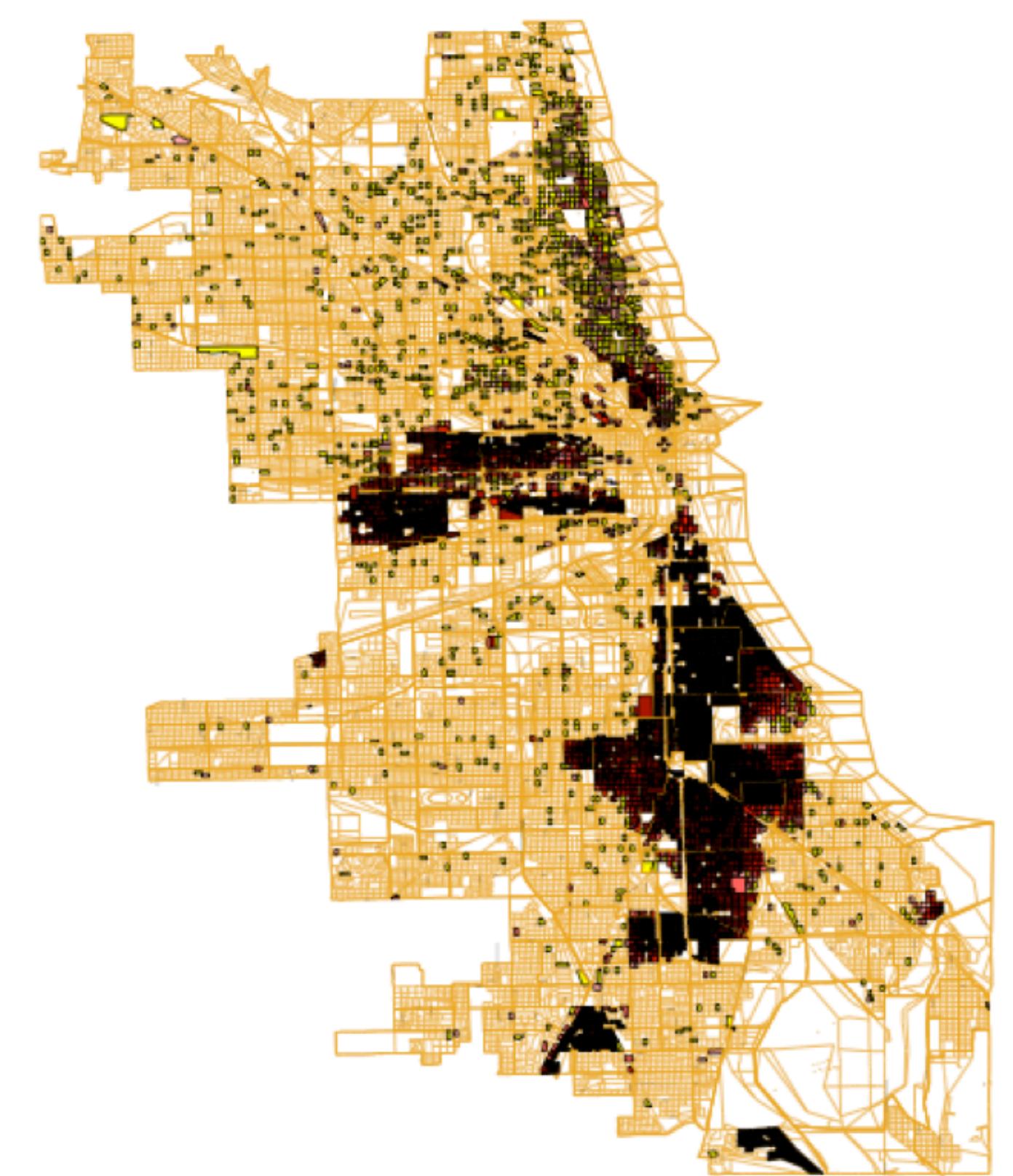
Natural spatial "signature" in cities

❖ Formation of homogeneous (according to some "type" or "class") neighbors in cities

❖ Which are the causes of "ghettization"?
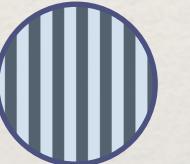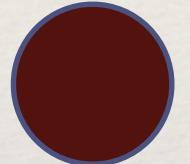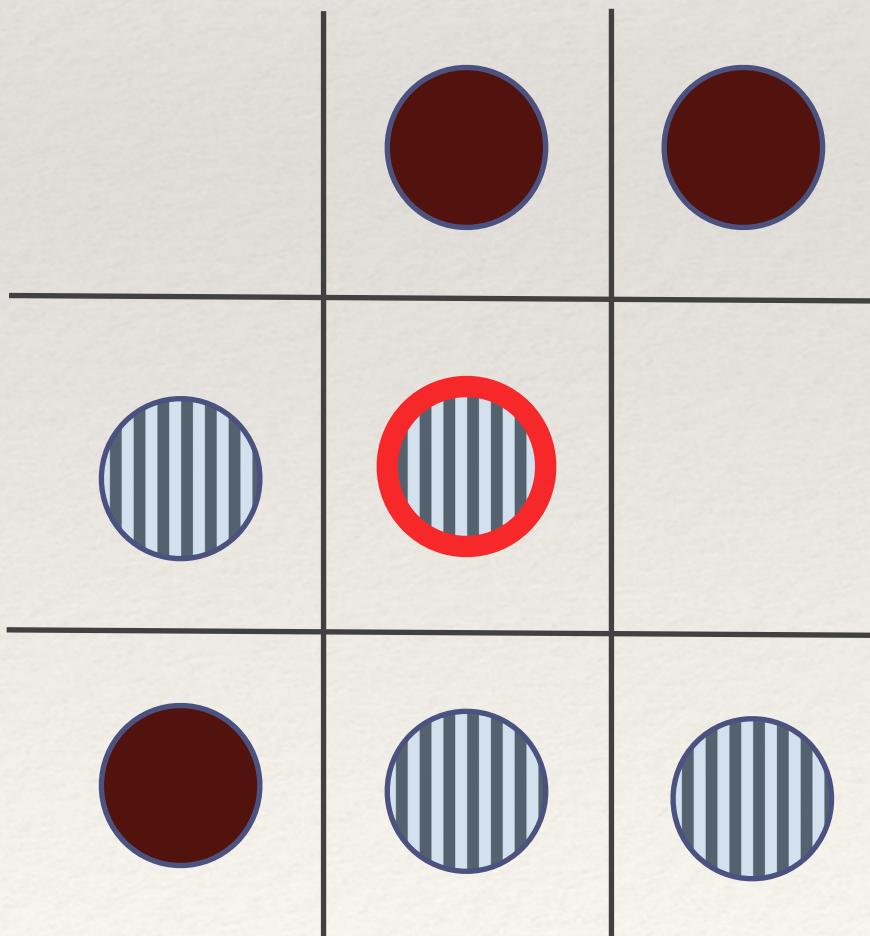

(a) *Chicago, 1940*
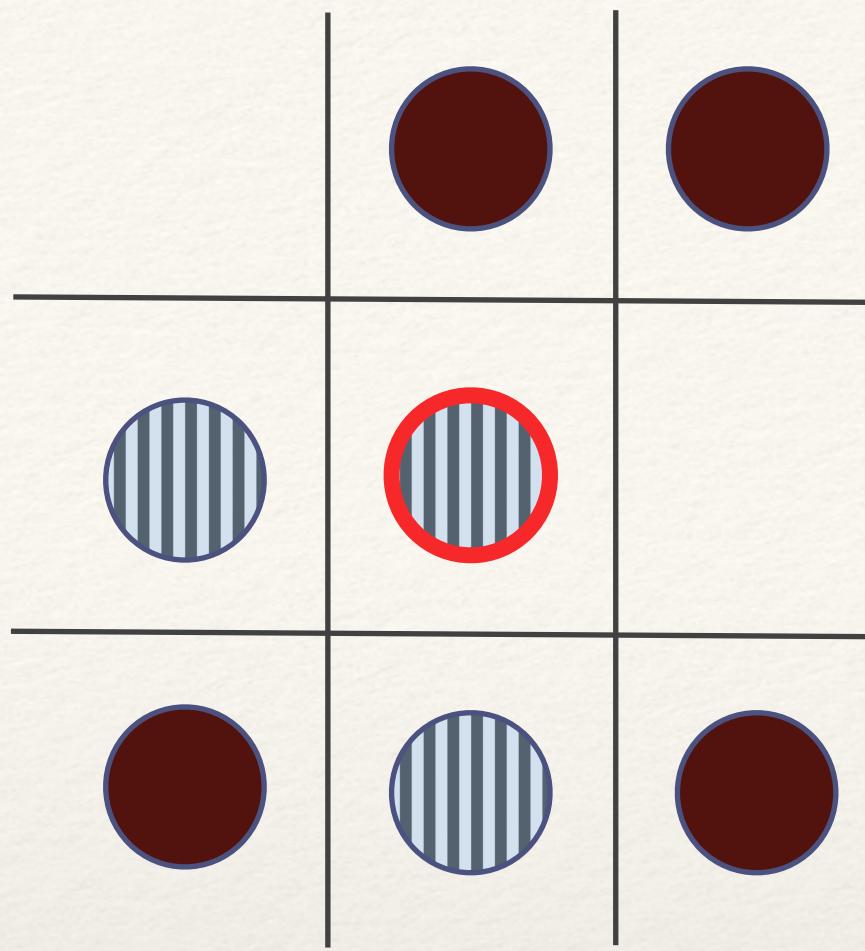
(b) *Chicago, 1960*

The Schelling model

❖ Can spatial segregation arise from the effect of homophily operating at a local level?

❖ Assumption: no individual want segregation explicitly

❖ Agents:

  ❖ two types:

  ❖ immutable characteristics

❖ Agents reside in a cell of a grid

  ❖ some cells contain agents

  ❖ some other cells are unpopulated

❖ Neighbors: 8 other cells "touching" an agent
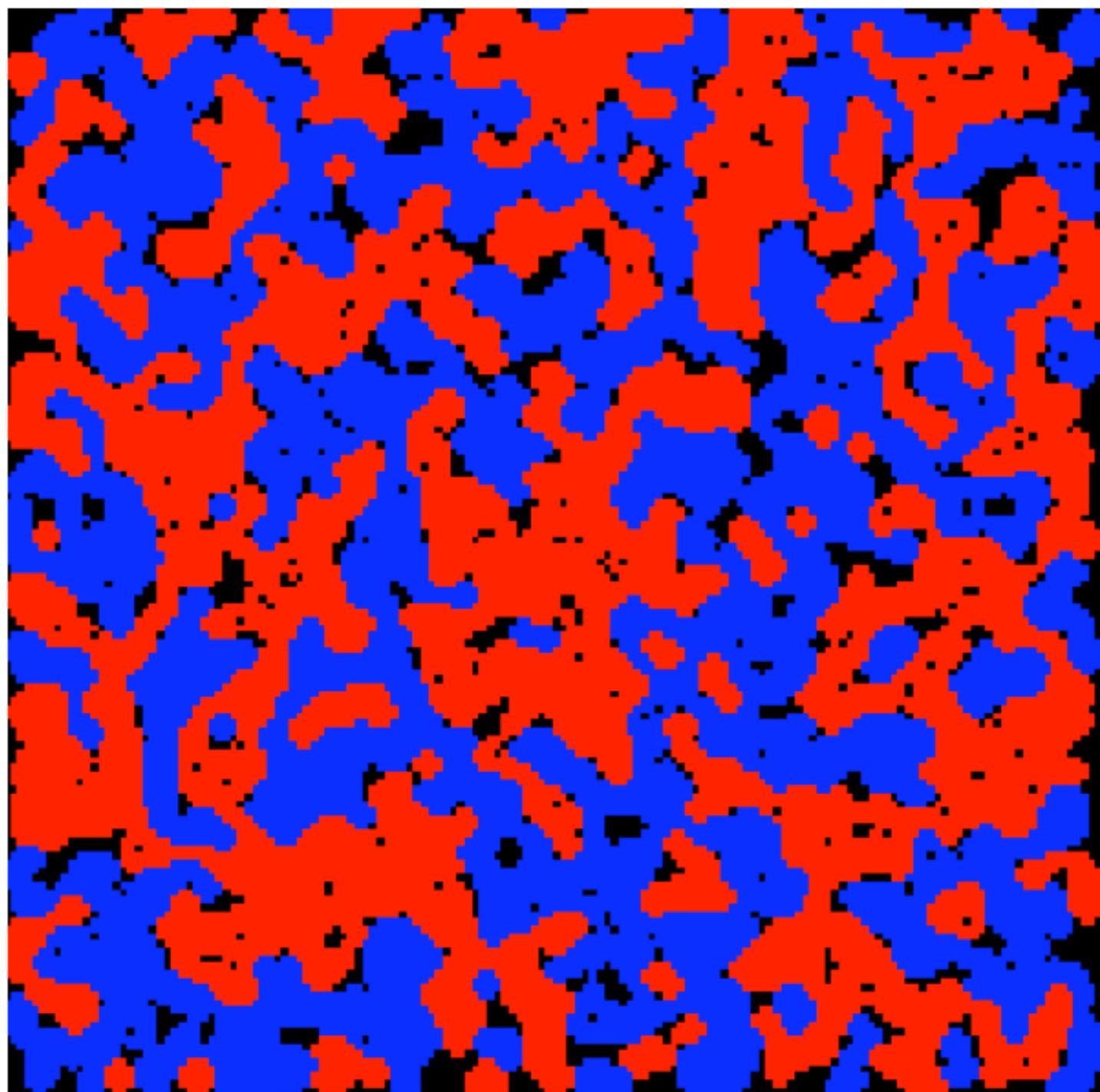
$t = 3 \Rightarrow :\text{-}($
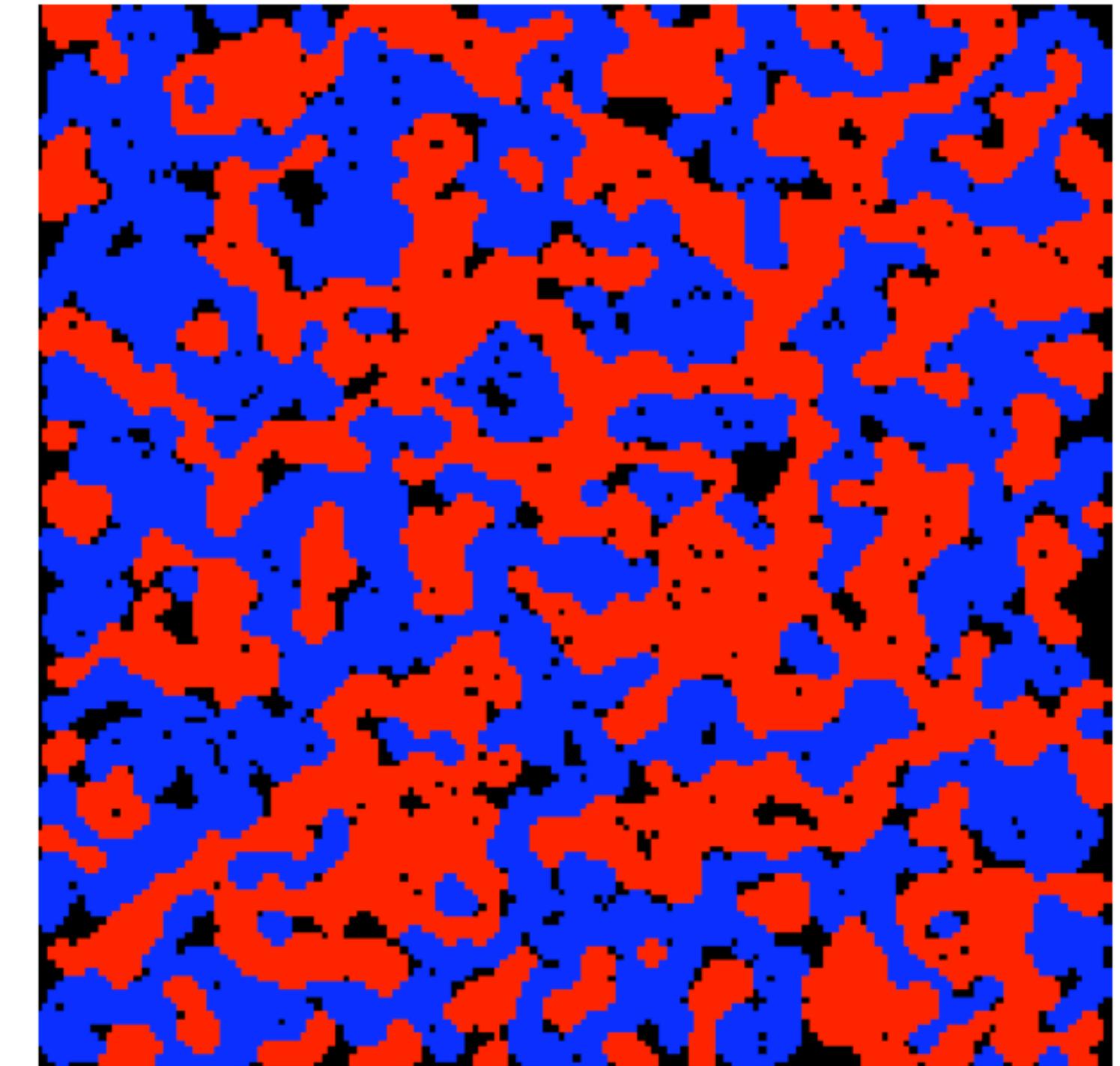
❖ Each agent wants to have at least t neighbors of their own type

❖ If an agent find $< t$ neighbors of the same type, then they are **unsatisfied**

❖ If unsatisfied, they want to **move**

Larger examples

- Computer simulations to look for patterns at larger scale

- We want to run different simulations and make some comparisons
=> integrated pattern?

- on the right: two runs of a simulations of the Schelling model with a threshold *t* of *3*

  - 150x150 grid

  - 10,000 agents

(a) *A simulation with threshold 3.*   (b) *Another simulation with threshold 3.*
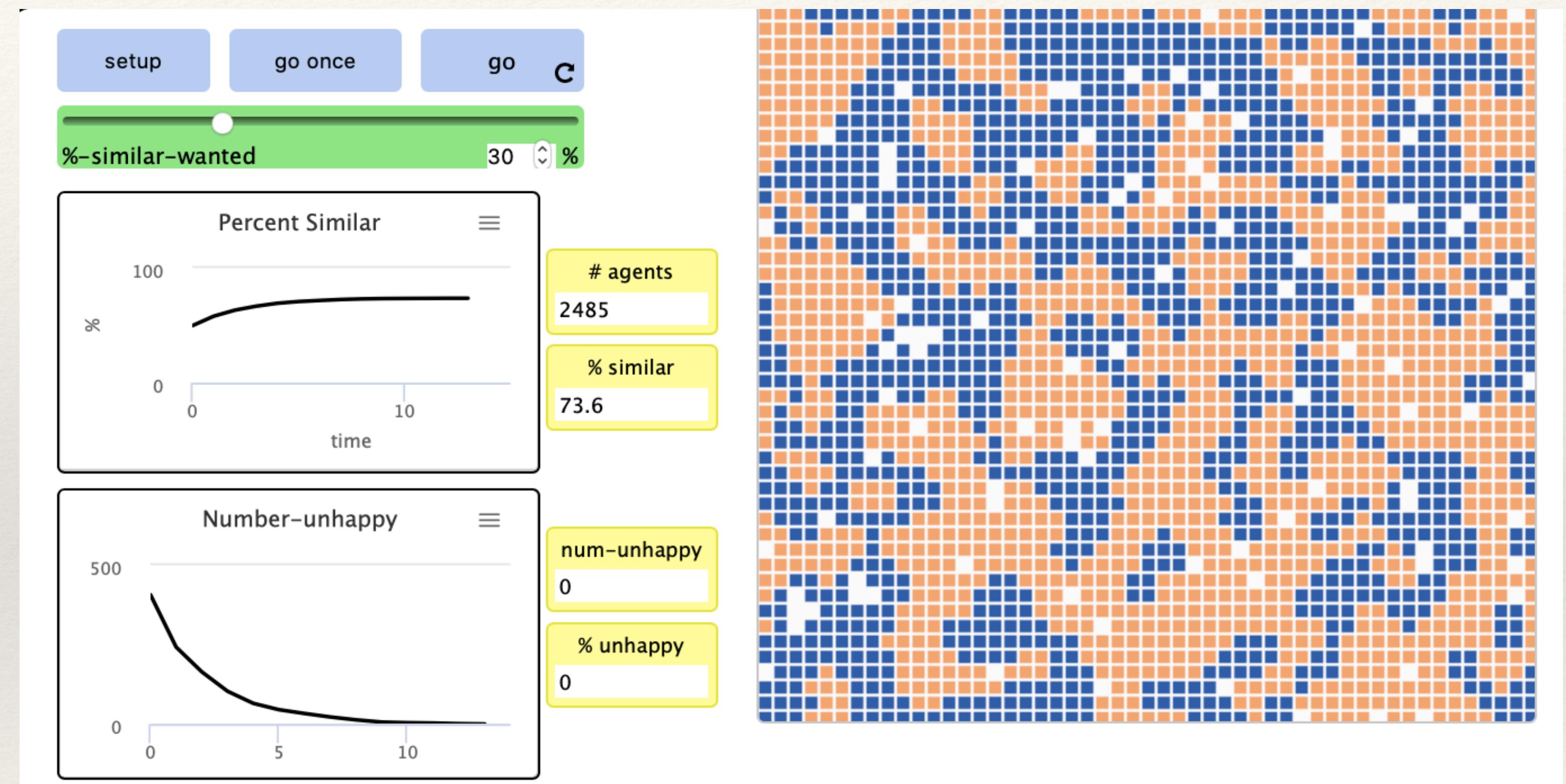
**Segregation emerges even when agents accept to be a minority!**
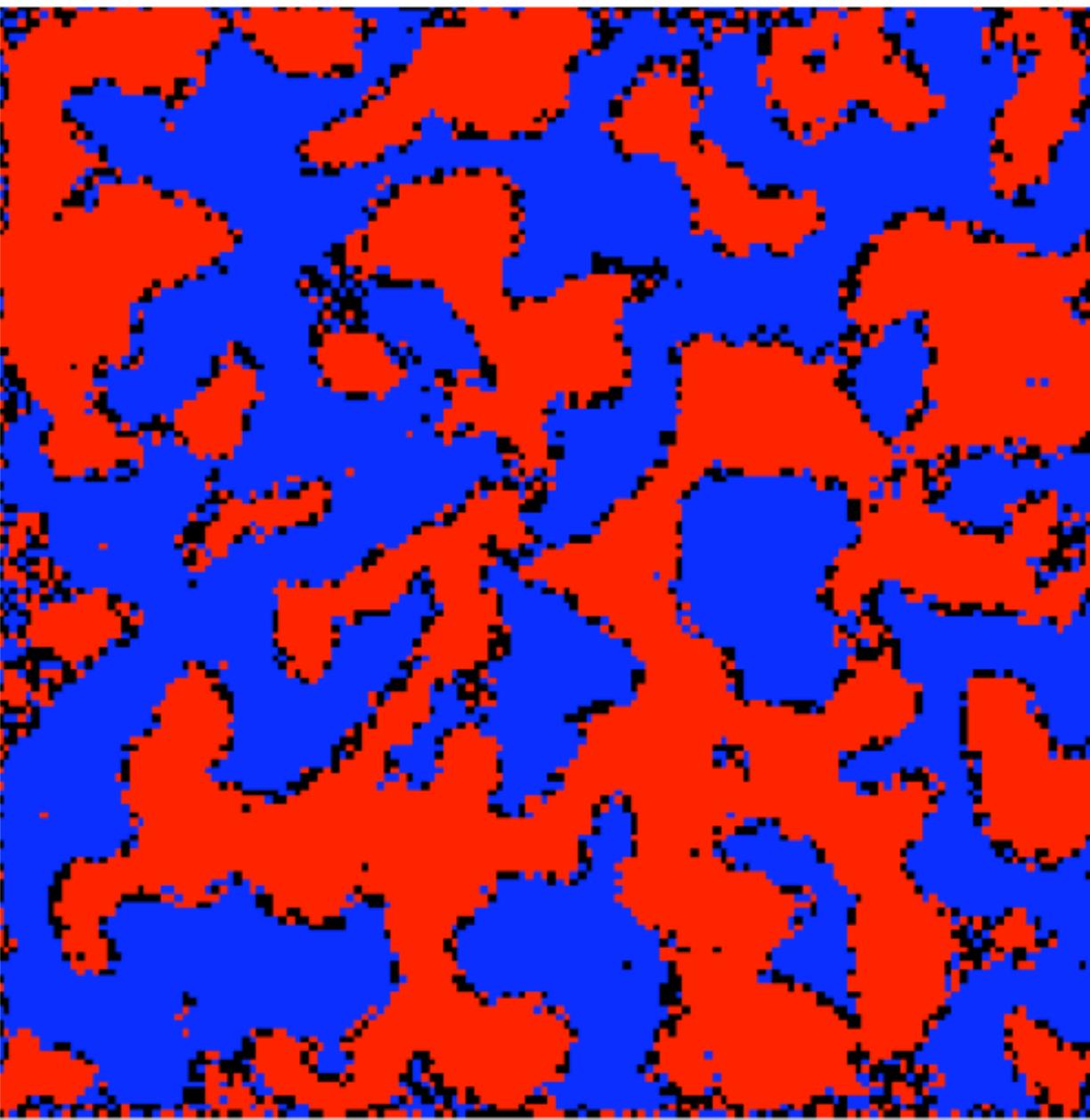
NetLogo

Agent based simulations
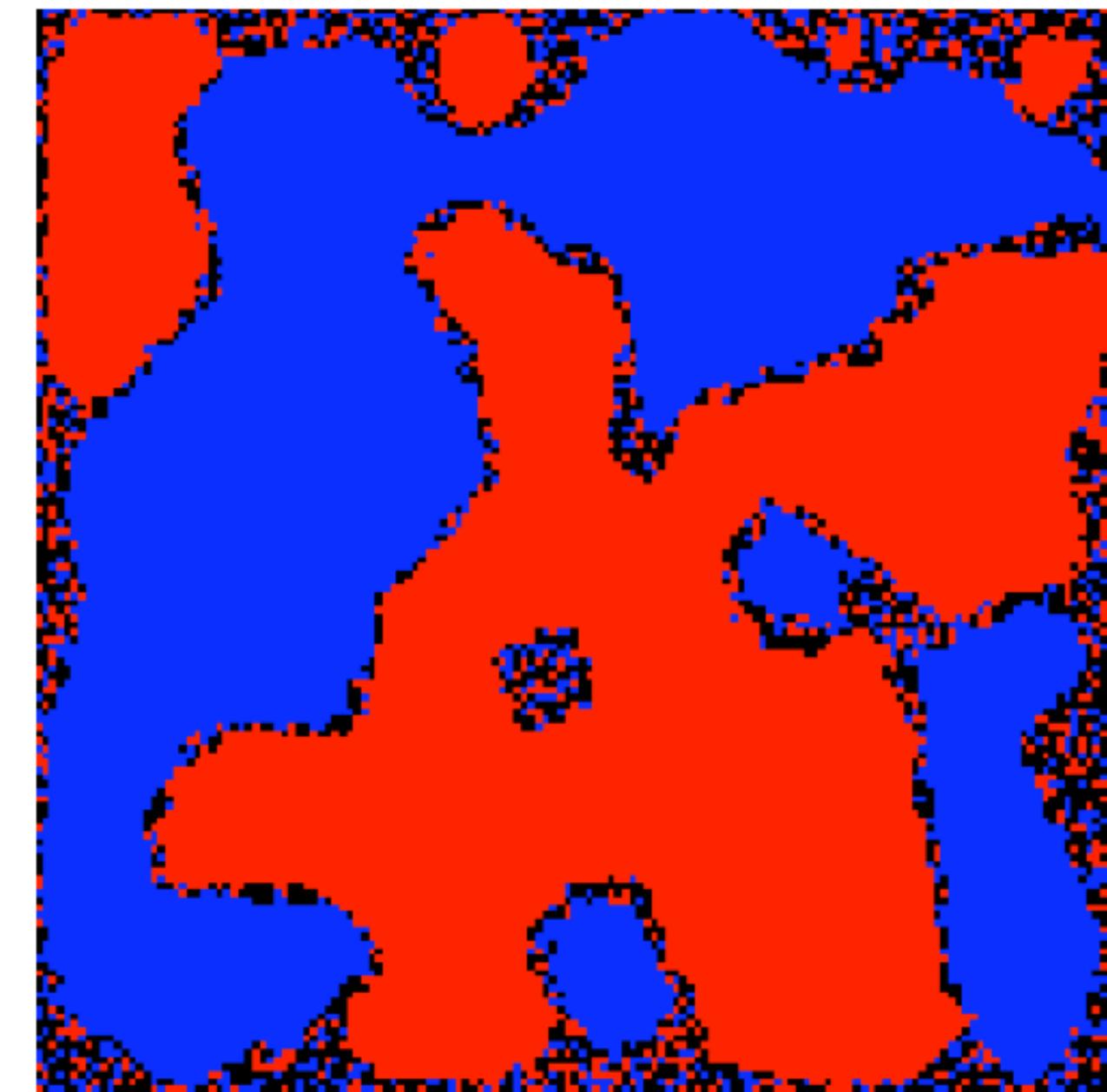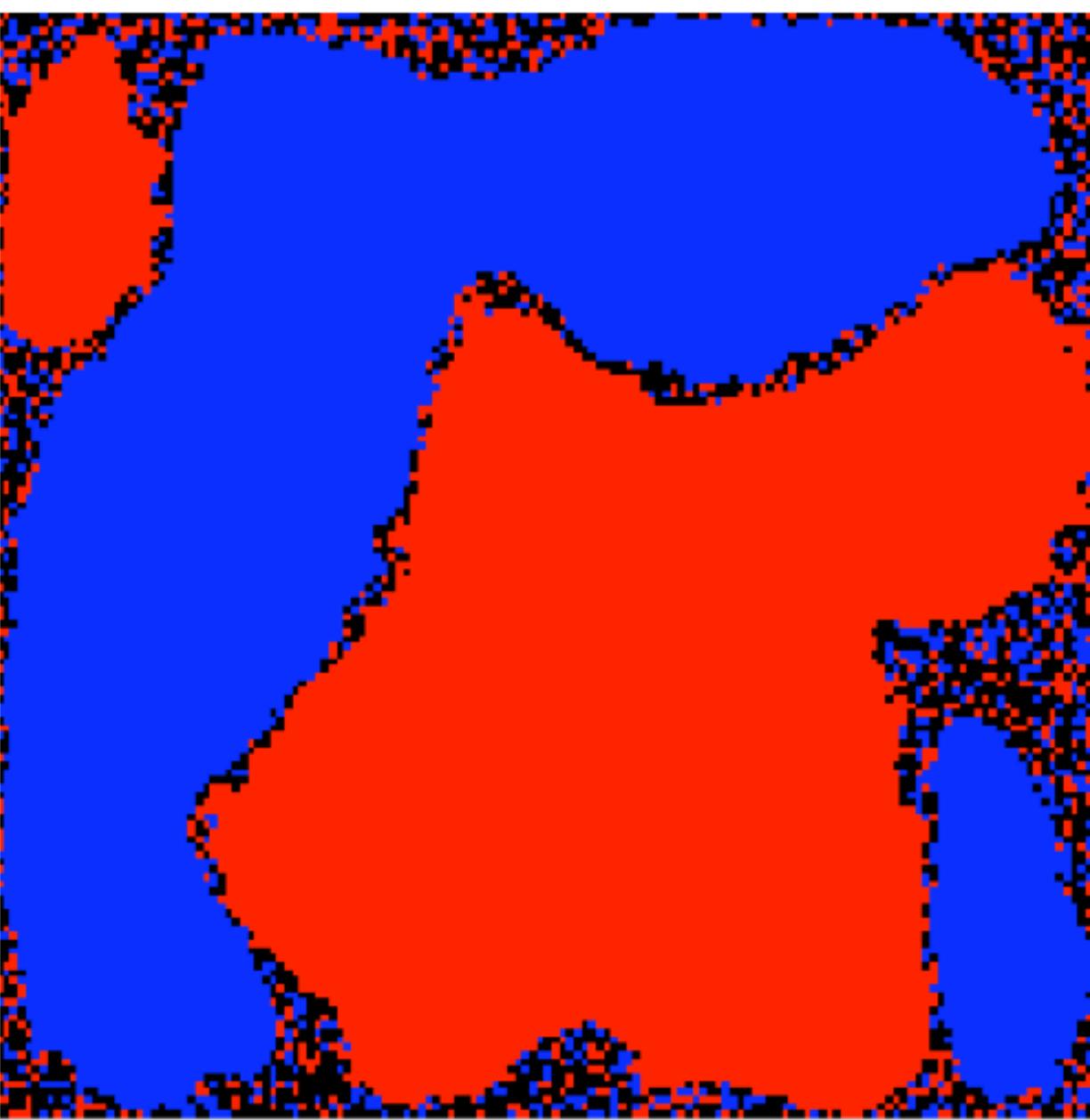
$t > 3 =>$
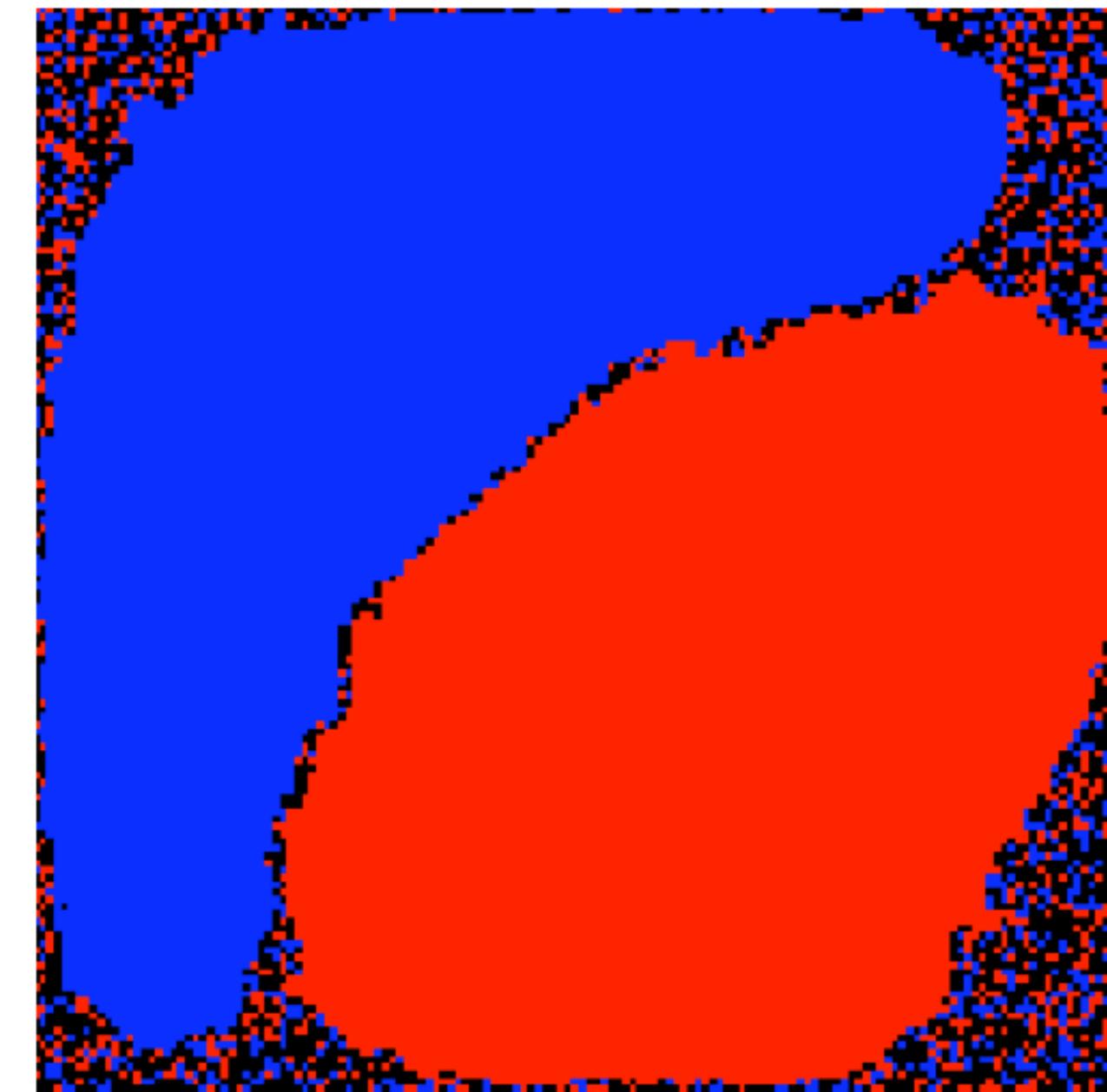
(a) *After 20 steps*

(b) *After 150 steps*

(c) *After 350 steps*

(d) *After 800 steps*
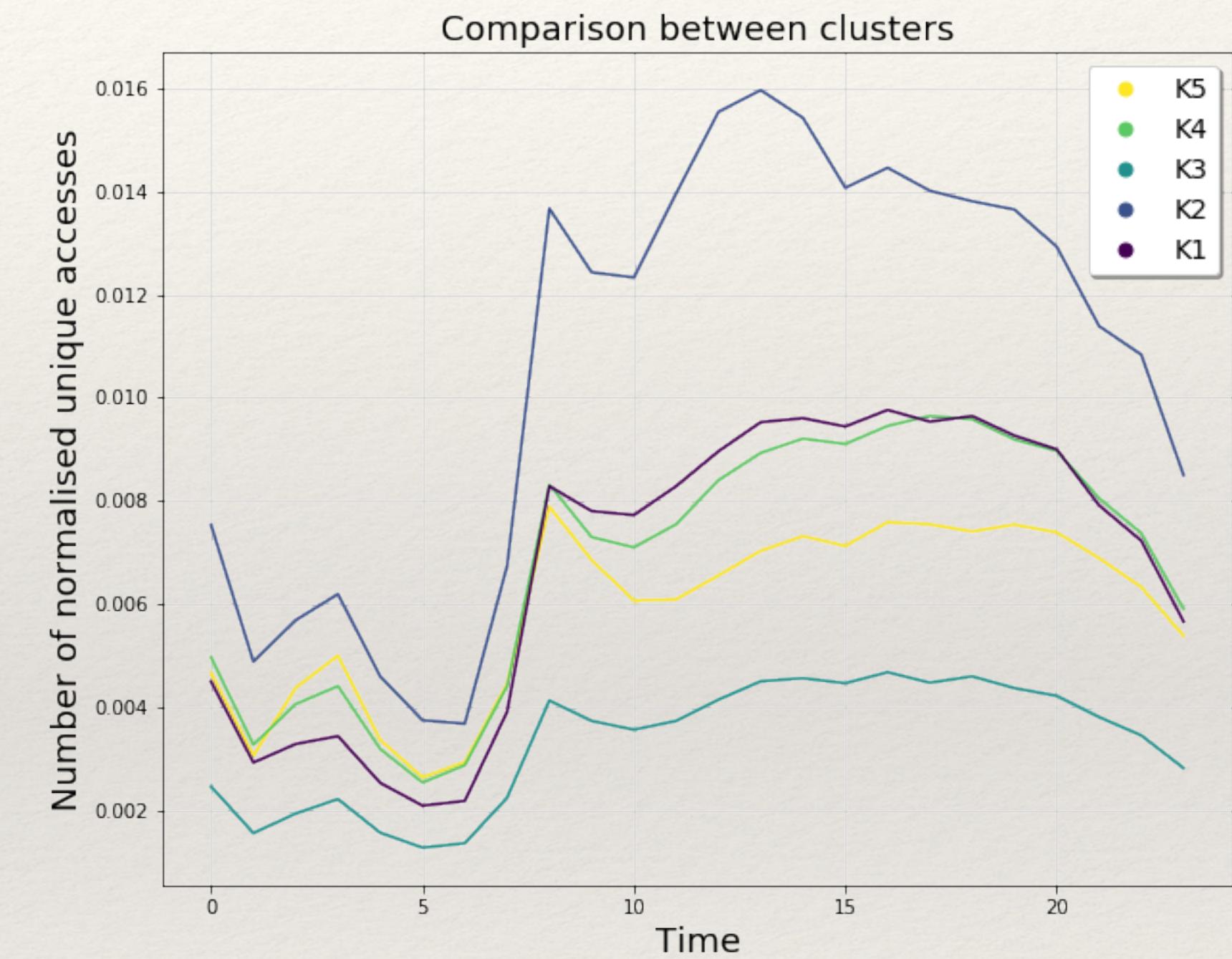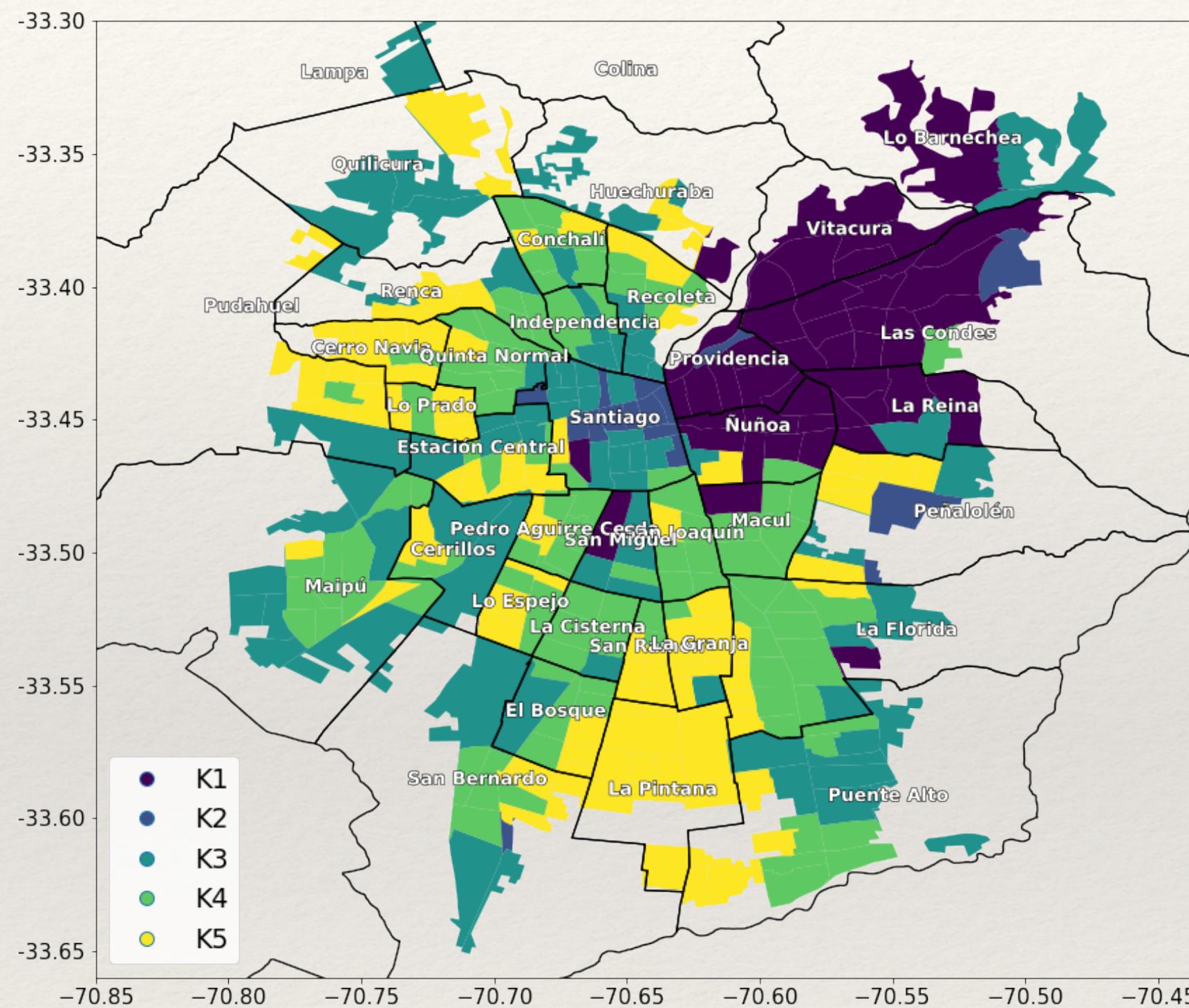
Segregation is (trivially) amplified in an intolerant society

Impacts of segregation

❖ Examples:

   ❖ on news consumption

   ❖ on outbreaks diffusion

Segregation vs information consumption

Study of geo-located accesses to websites of **news media** revealed strong differences between different "classes" of the population of SCL.

S Vilella, D Paolotti, G Ruffo, L Ferres, News and the city: understanding online press consumption patterns through mobile data, https://arxiv.org/abs/1907.02480

Segregation by age and virus transmission

Crowds take in the the cherry blossoms a
visitors from holding *sakura*-viewing par

COMMENTARY / JAPAN

Why is Japan still a cor

BY OSCAR BOYD
STAFF WRITER

At the time of writing, Japan has just
coronavirus. That's 900 cases record
first person — a man who had travel
have the disease while in a Japanese

In Italy, the first case was recorded t
23. Shortly after, 50,000 people were quarantined in a handful of towns in
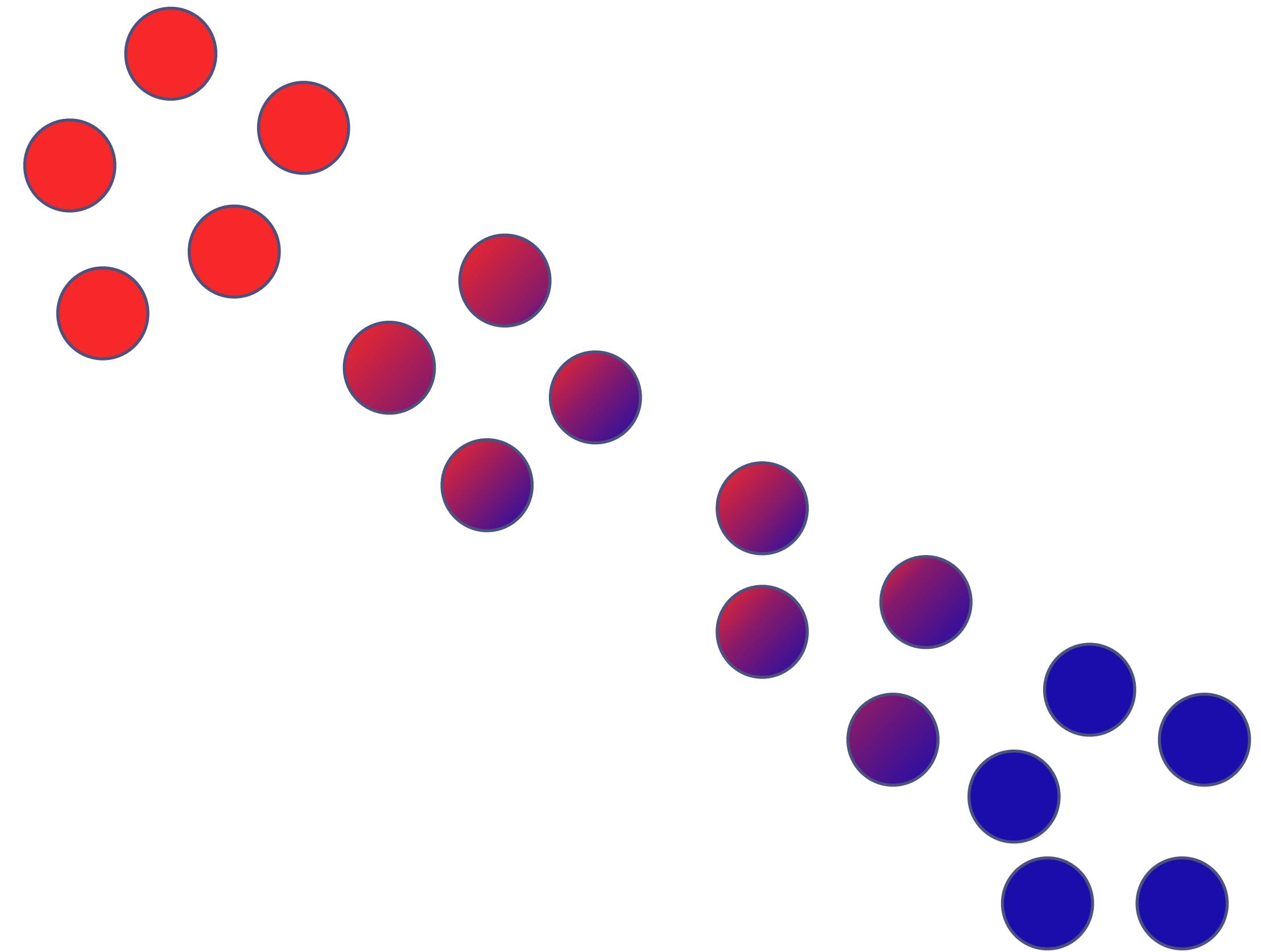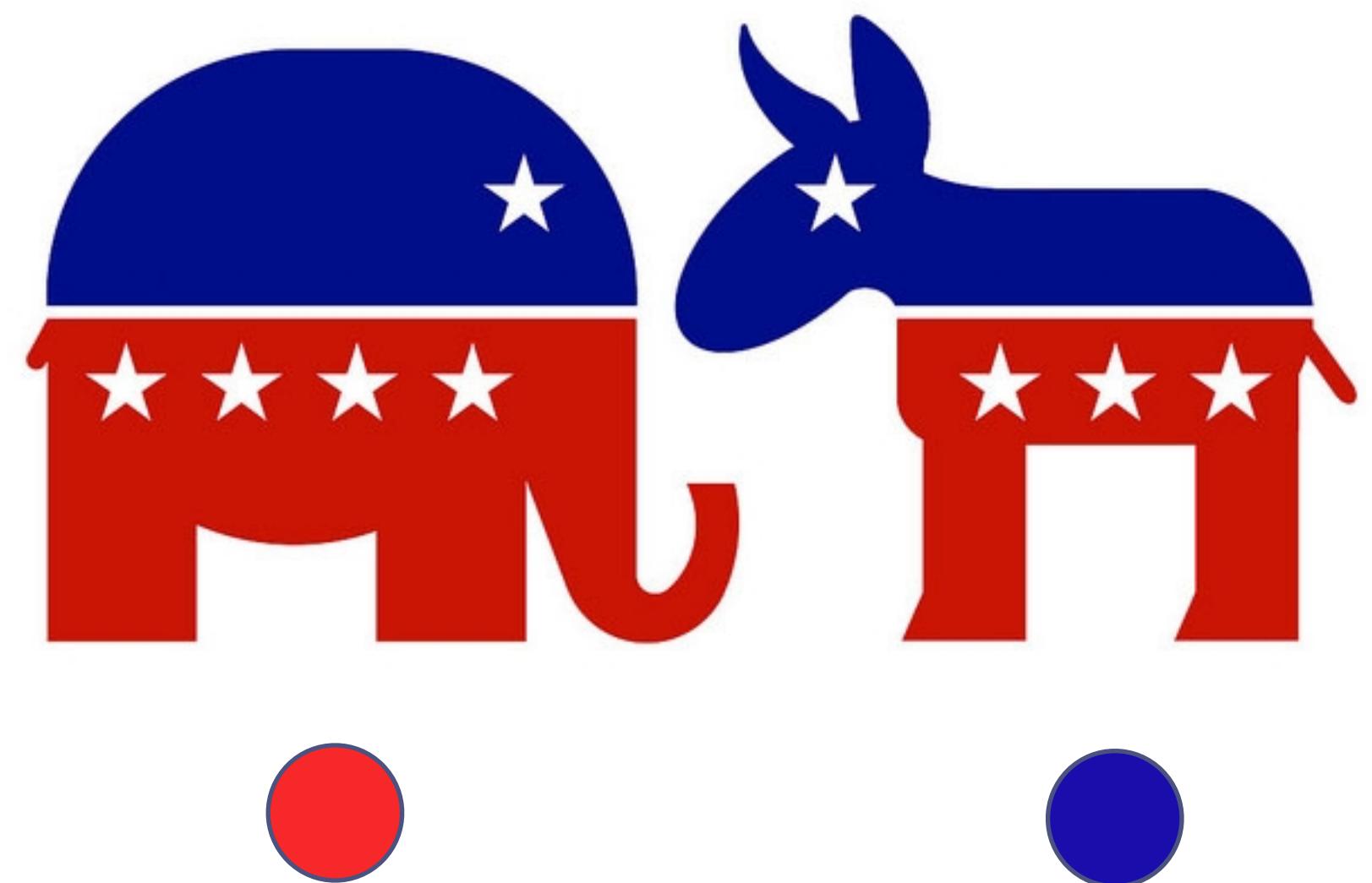
thought: that Japan is
pread in the way it has
ns: relatively less social
to wear masks when
rus, ⊠ **already high**
e voluntary self-
at Japan is flattening

WARNING

hypothesis not supported by
scientific evidences, yet!

🔍 CLICK TO ENLARGE
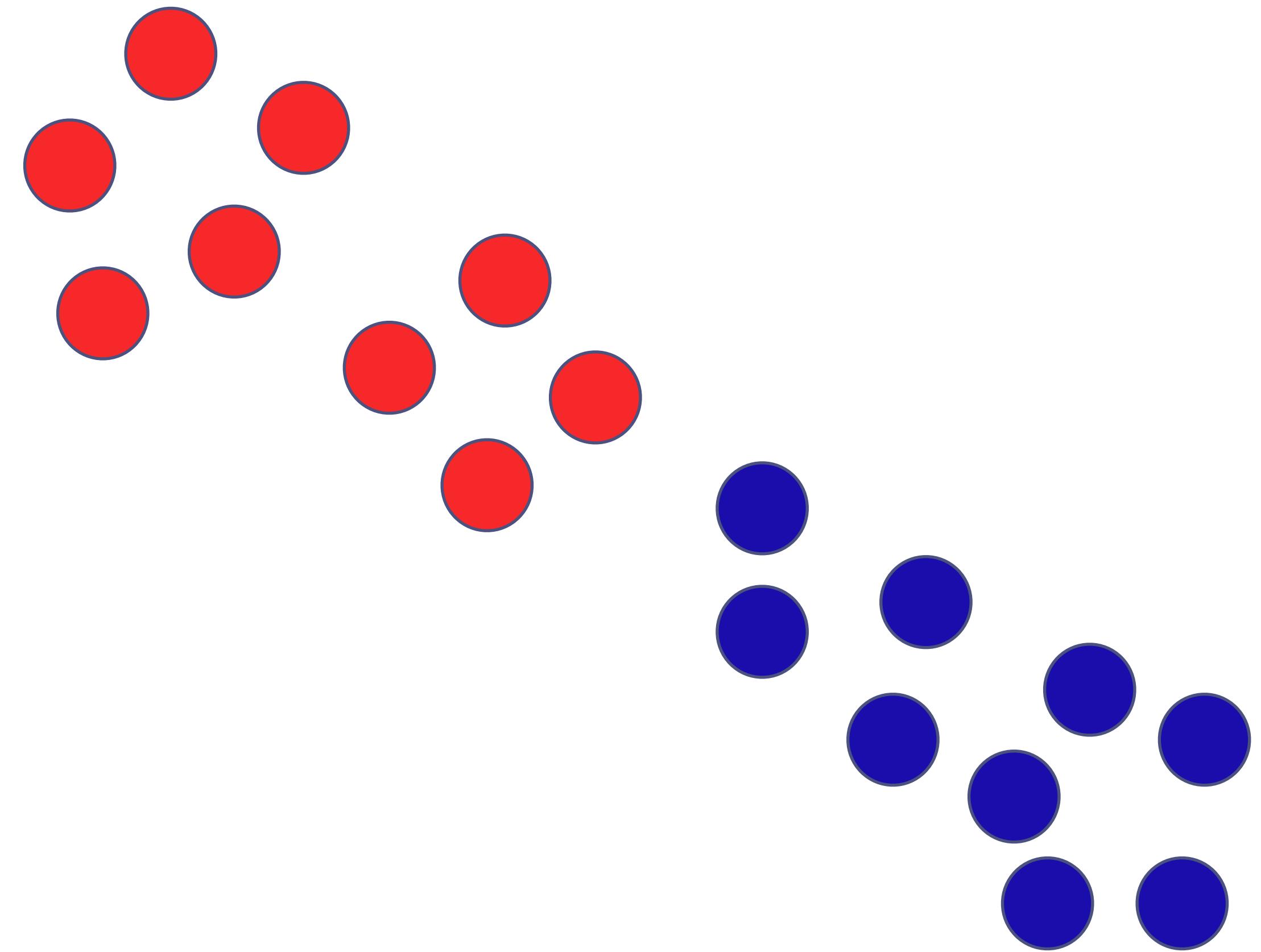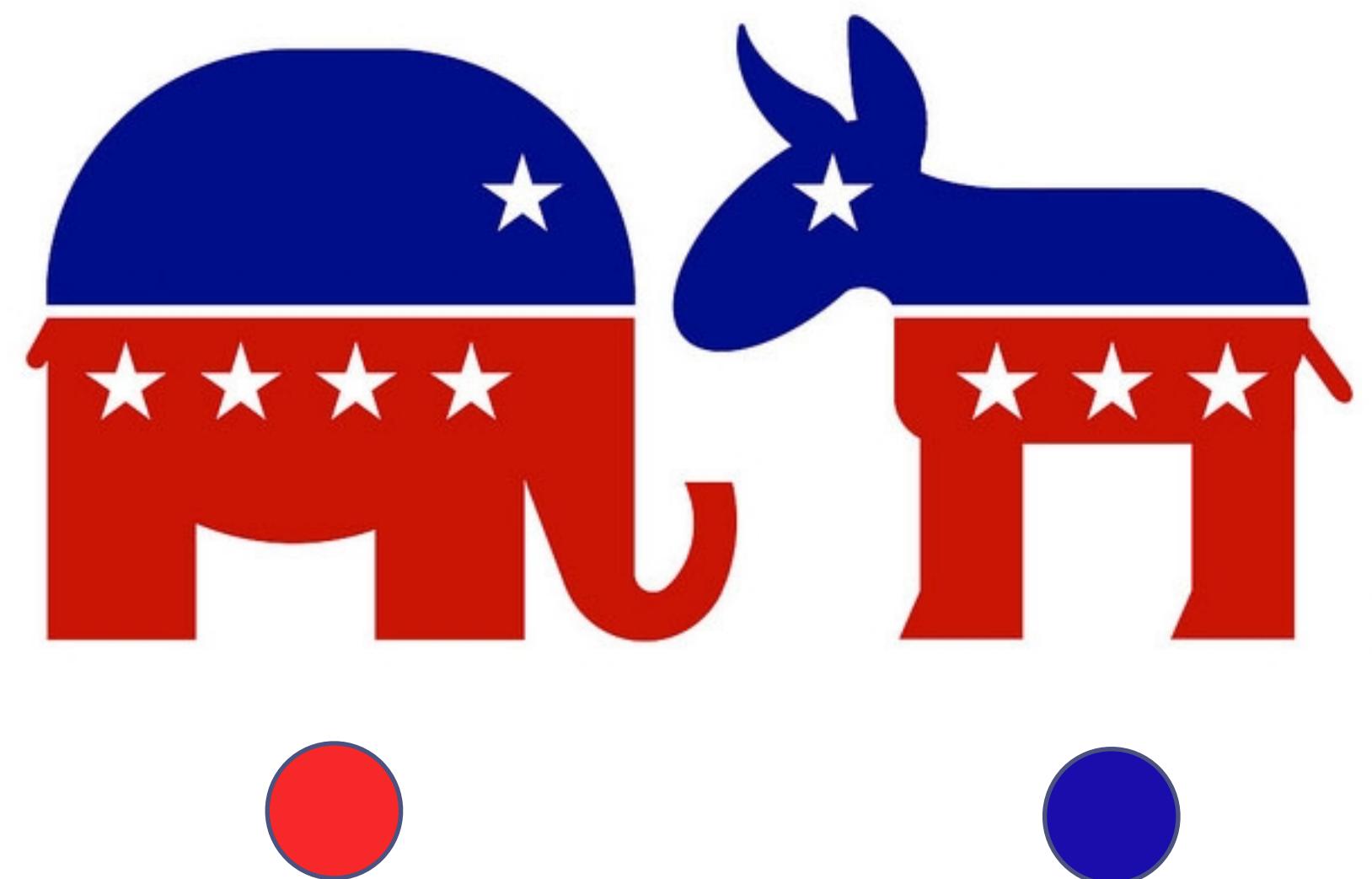
*"**Polarization** is both a state and a process. Polarization as a **state** refers to the extent to which opinions on an issue are opposed in relation to some theoretical maximum. Polarization as a **process** refers to the increase in such opposition over time."*

*– DiMaggio et. al, American Journal of Sociology, 1996*

Polarization
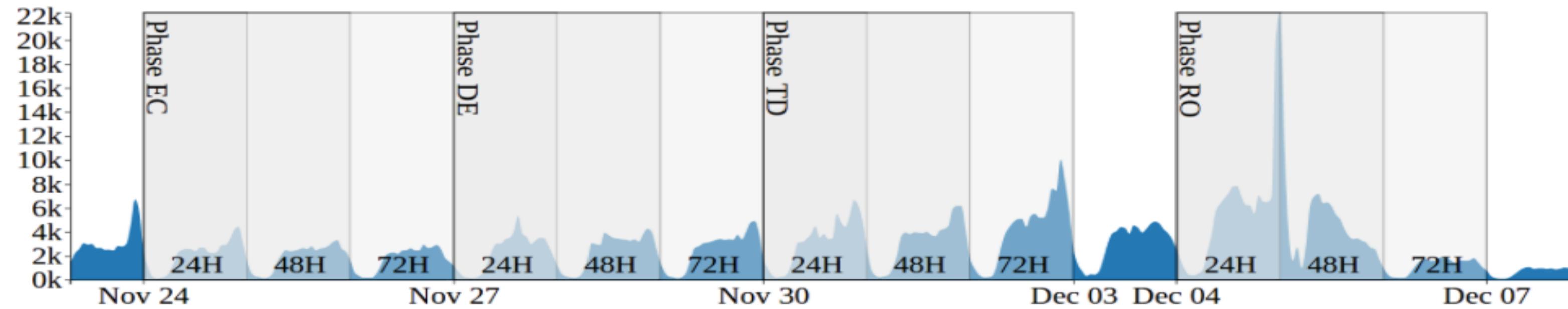
Polarization

Italian 2016 Constitutional Referendum
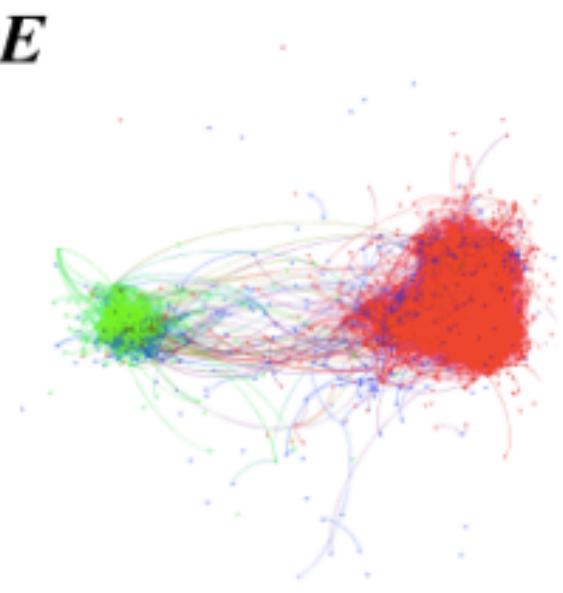
Collected Tweets
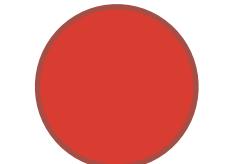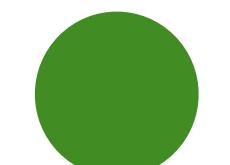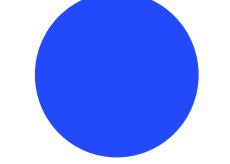
Retweet Network
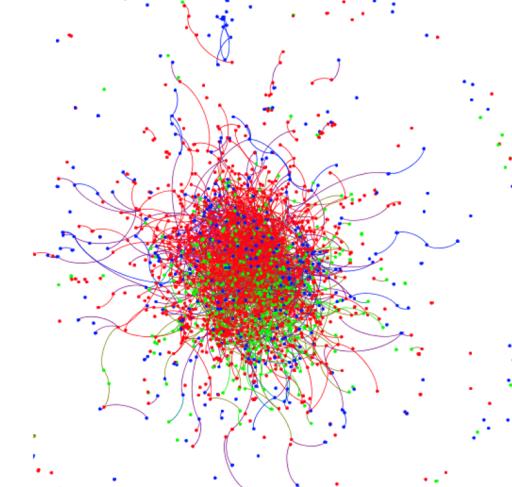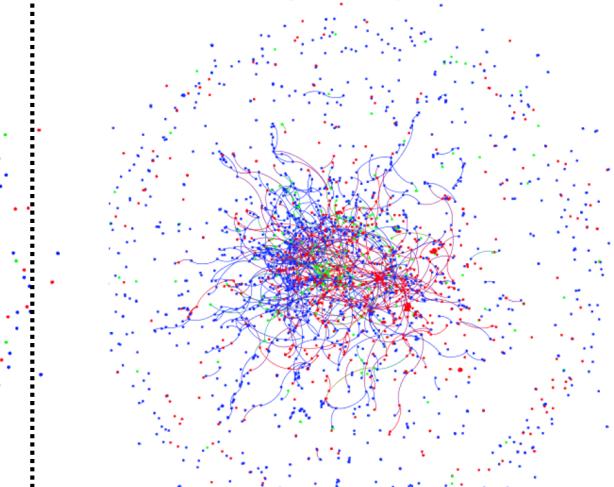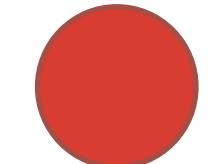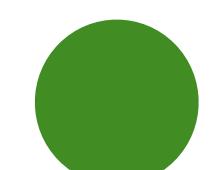
stance detected as **AGAINST**
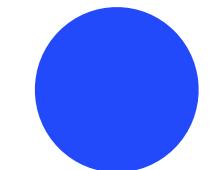
strong signal of **homophily**

stance detected as **IN FAVOR**

stance detected as **NONE**

M Lai, M Tambuscio, V Patti, P Rosso, G. Ruffo, Stance Polarity in Political Debates: a Diachronic Perspective of Network Homophily and Conversations on Twitter, Data & Knowledge Engineering Journal, online: September 2019

Italian 2016 Constitutional Referendum

M Lai, M Tambuscio, V Patti, P Rosso, G. Ruffo, Stance Polarity in Political Debates: a Diachronic Perspective of Network Homophily and Conversations on Twitter, Data & Knowledge Engineering Journal, online: September 2019

Issues with studying polarization

- **State**: difficult to detect

  - e.g., NLP based techniques as "*stance detection*" are great, but errors prone

- **Process**: difficult to observe

  - e.g., opinions can mitigate or polarize over time, but people do not necessarily express them

- Polarization by **selection** and by **influence**

  - do I get along with people that share my opinion, or I am influenced by people with whom I get along? or both processes are at interplay?

- "**Social contagion**" is more rational than we may think…

Conformity experiment and group influence

Asch Conformity Experiment

https://www.youtube.com/watch?v=NyDDyT1lDhA
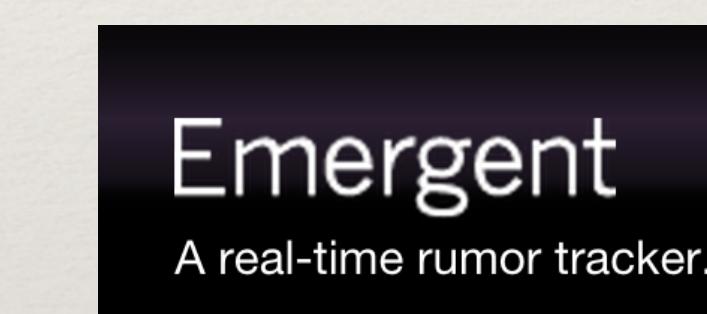
Modeling the spread of misinformation

Questions

❖ Is fact-checking effective against the diffusion of fake-news?
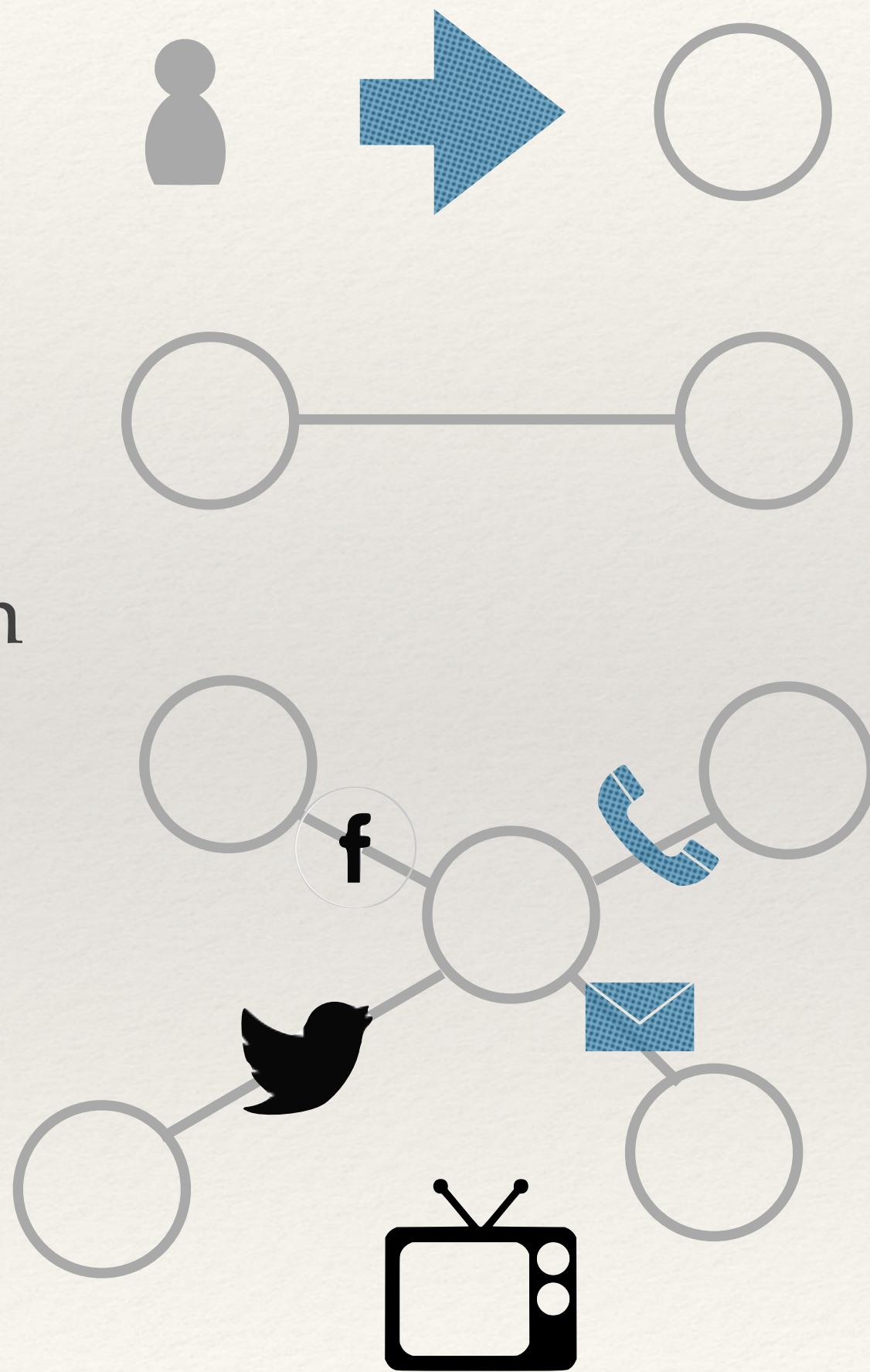
❖ Do "echo-chambers" play a role as inhibitors or facilitators of fake-news spreading?

Networks and their context
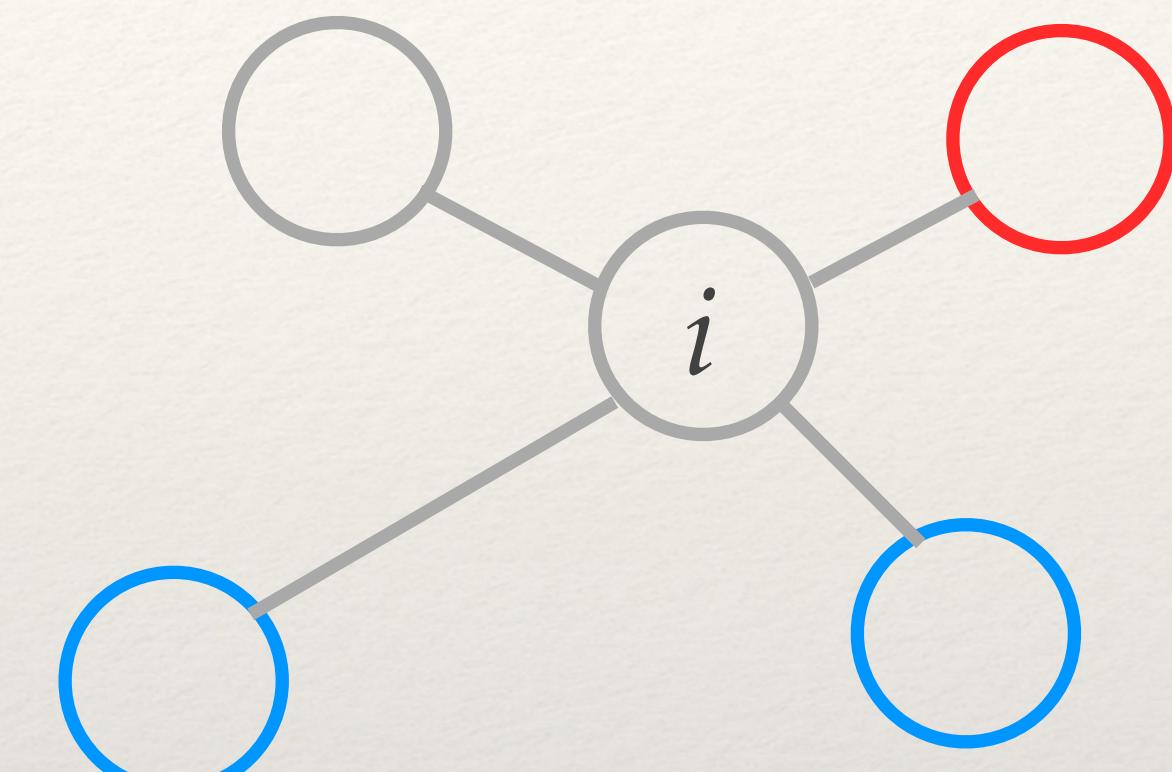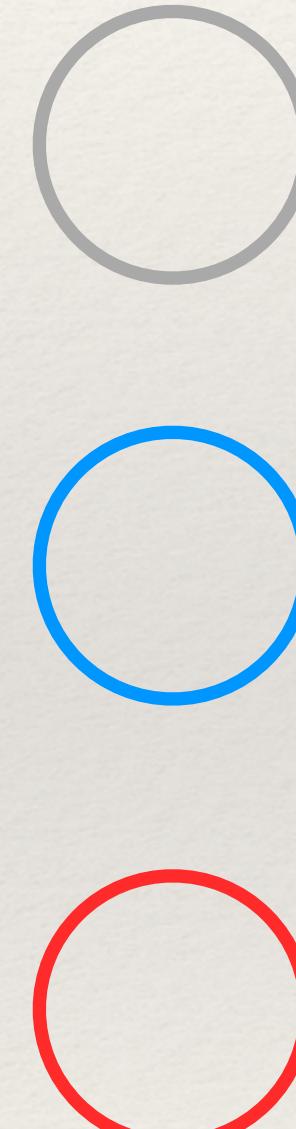
- nodes are **actors** involved in a **generic** social network (no assumption is given)

- links are **social relationships**

- nodes can be exposed to news from both **internal and external sources** and via different communication devices

- **network topologies** can be created artificially or built from real data

- The **news is factually false** (can be debunked or someone else has already debunked it)

- We need a **model** for predictions and what-if analysis; data for validation and tuning only
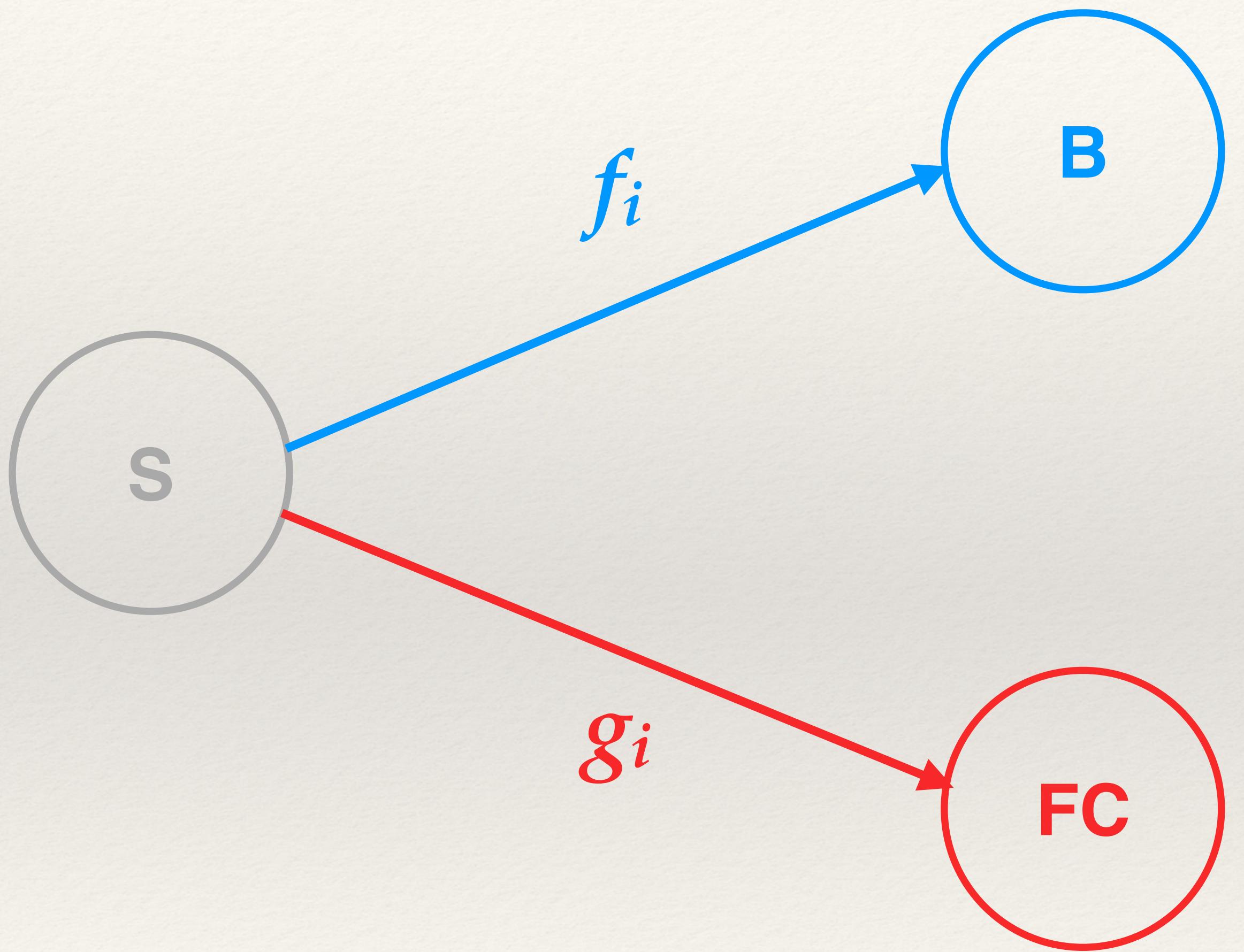
Node states in the SBFC model

❖ Susceptible

❖ Believer

❖ Fact-Checker
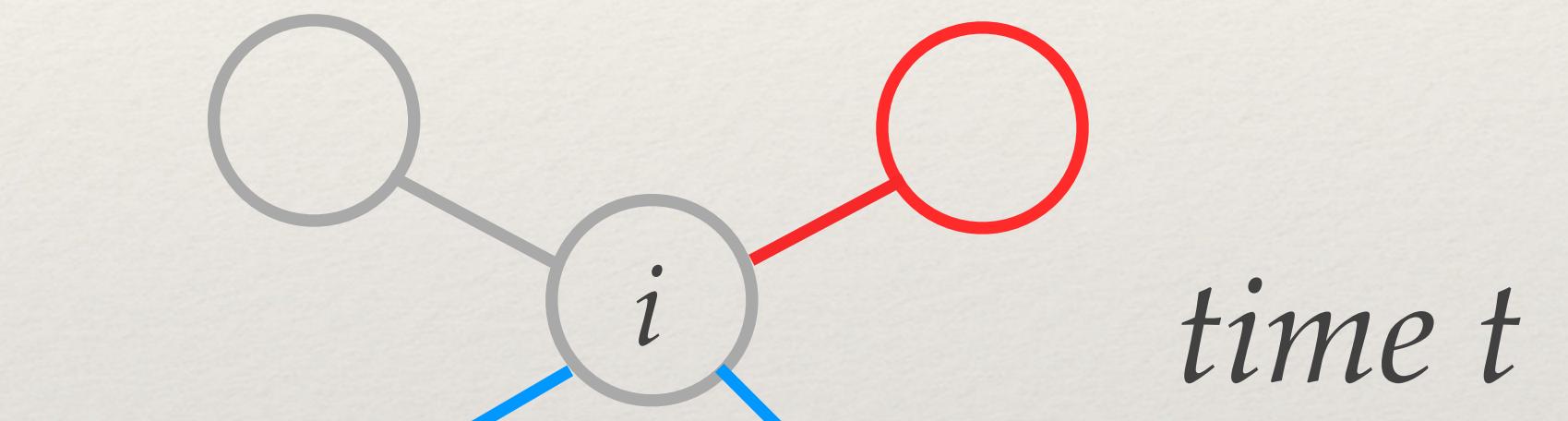
neighbors of i: n_i
credibility of the hoax: α
spreading rate: β

From Susceptible to Believer/Fact-Checker
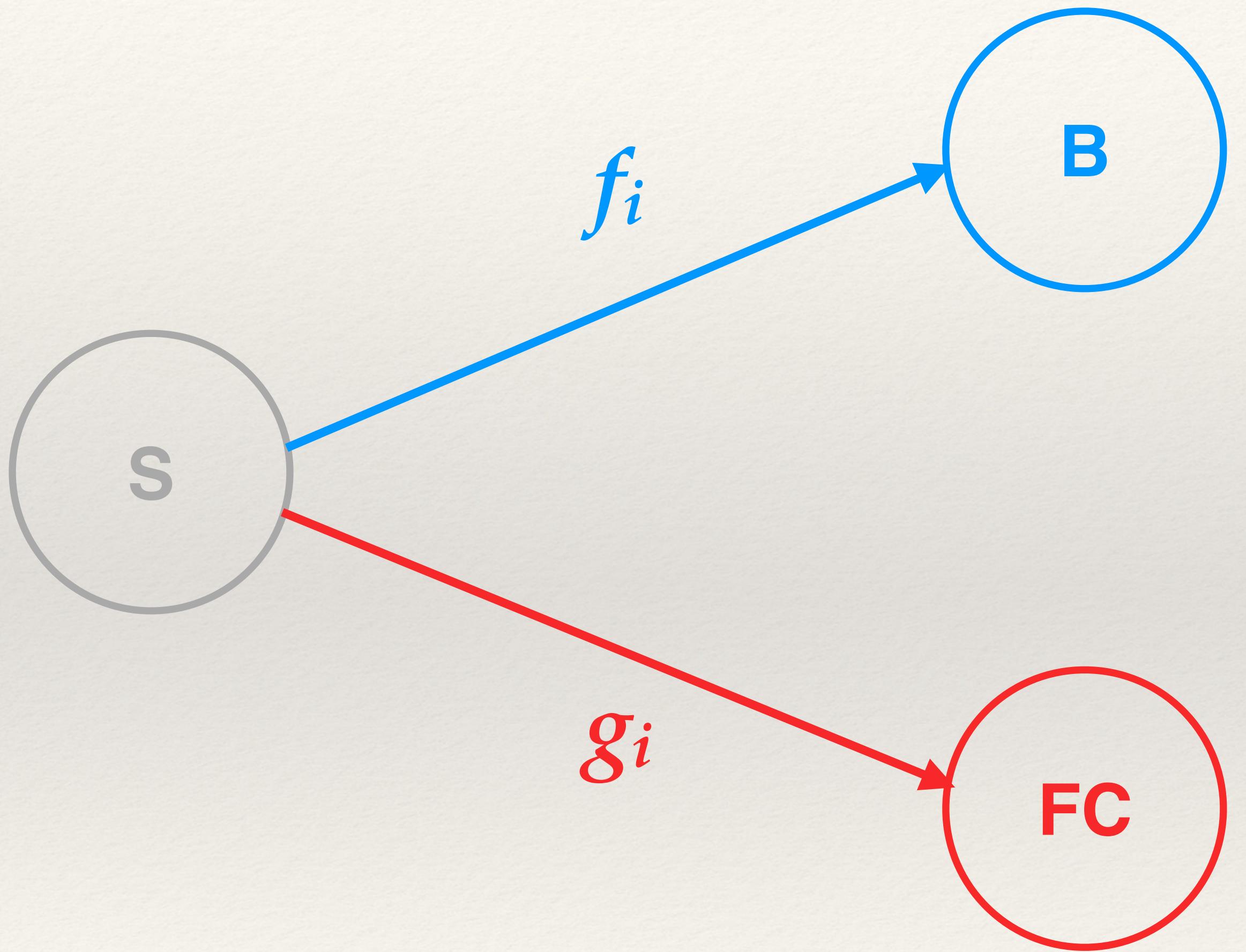
$$f_i(t) = \beta \frac{n_i^B(t)(1+\alpha)}{n_i^B(t)(1+\alpha) + n_i^F(t)(1-\alpha)}$$

$$g_i(t) = \beta \frac{n_i^F(t)(1-\alpha)}{n_i^B(t)(1+\alpha) + n_i^F(t)(1-\alpha)}$$

time t

From Susceptible to Believer/Fact-Checker

$$f_i(t) = \beta \frac{n_i^B(t)(1+\alpha)}{n_i^B(t)(1+\alpha) + n_i^F(t)(1-\alpha)}$$

f_i

g_i

time t+1
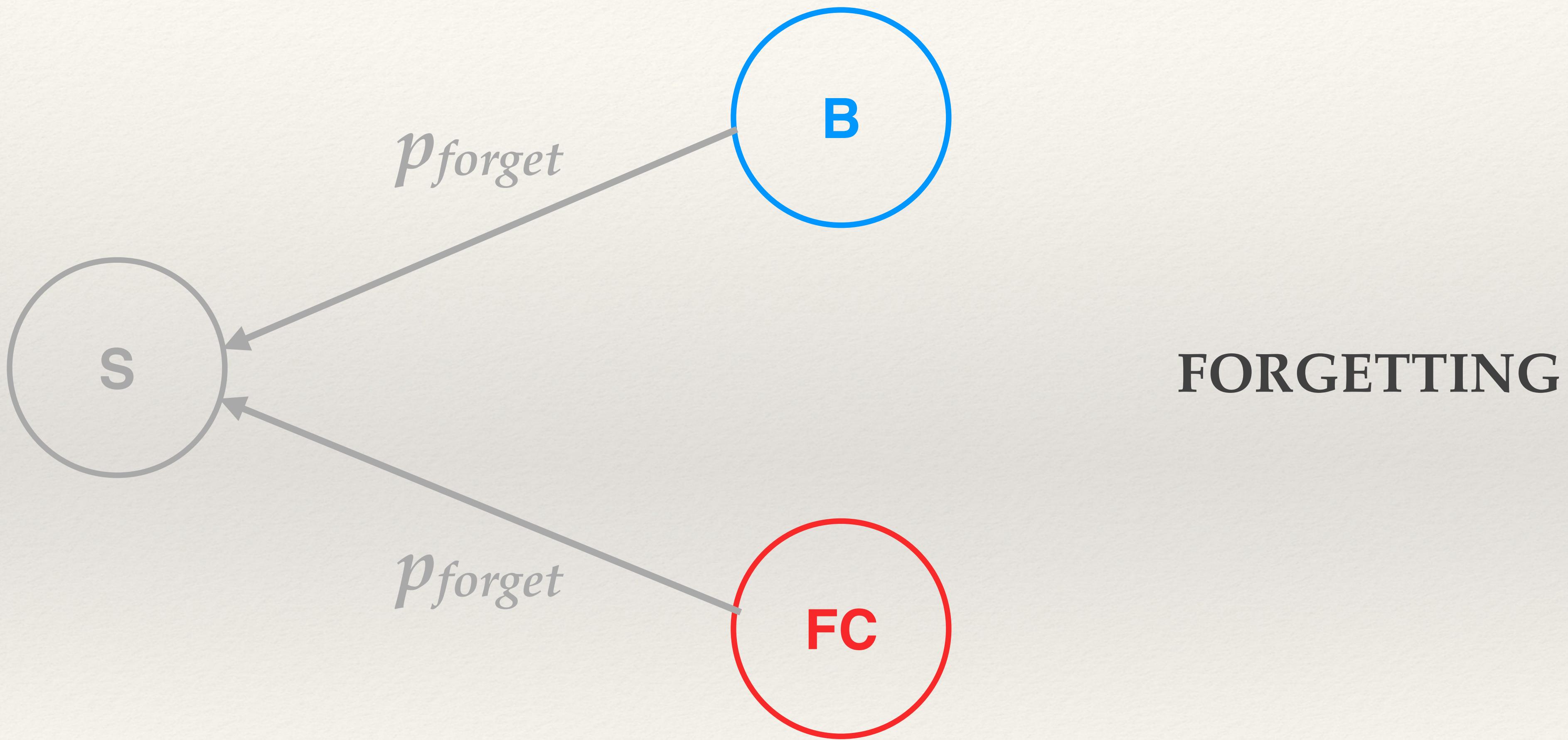
$$g_i(t) = \beta \frac{n_i^F(t)(1-\alpha)}{n_i^B(t)(1+\alpha) + n_i^F(t)(1-\alpha)}$$
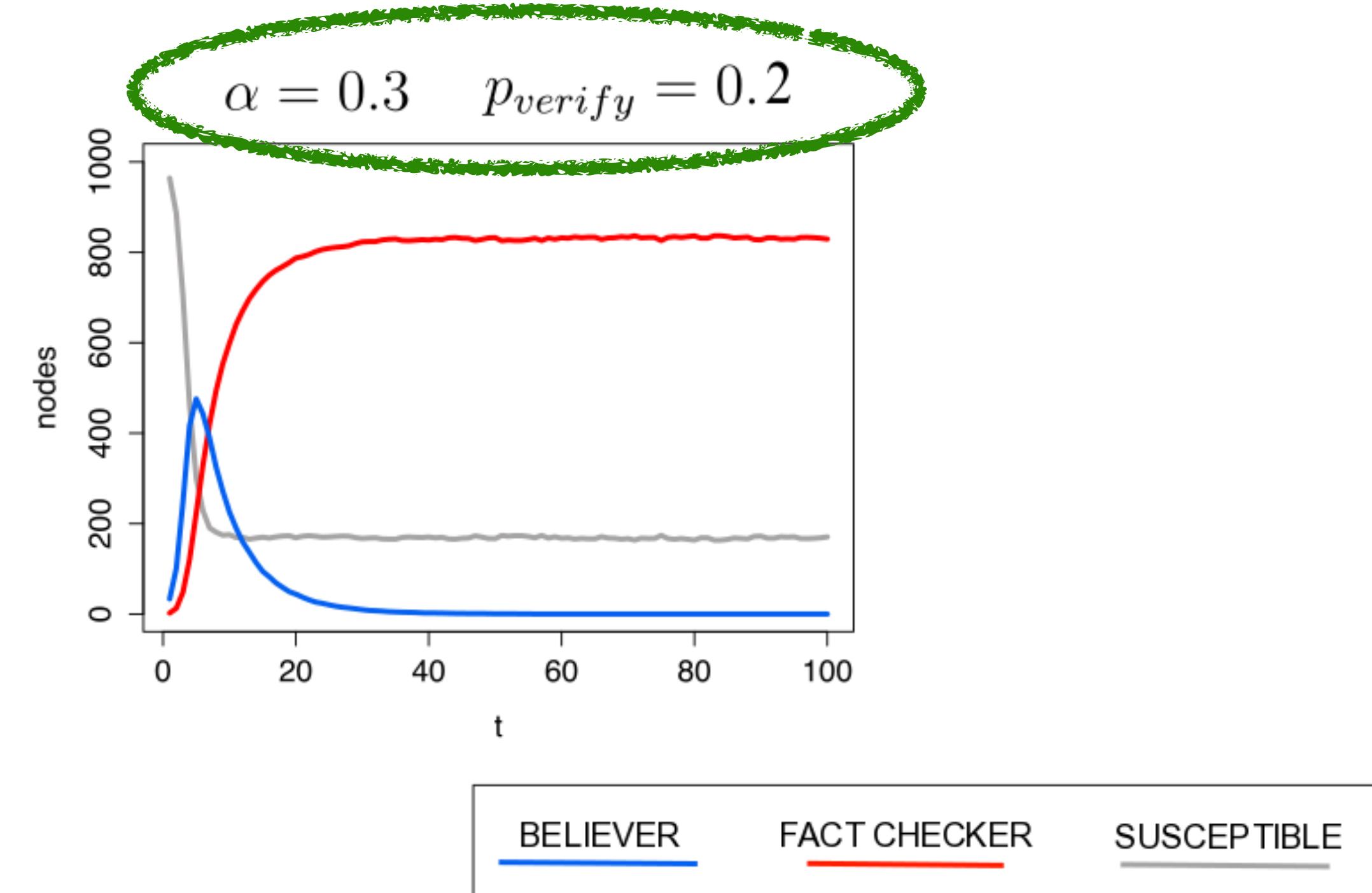
From Believer to Fact-Checker

B

p_{verify}

FC

VERIFYING
probability of fact-checking (or just deciding not to believe)
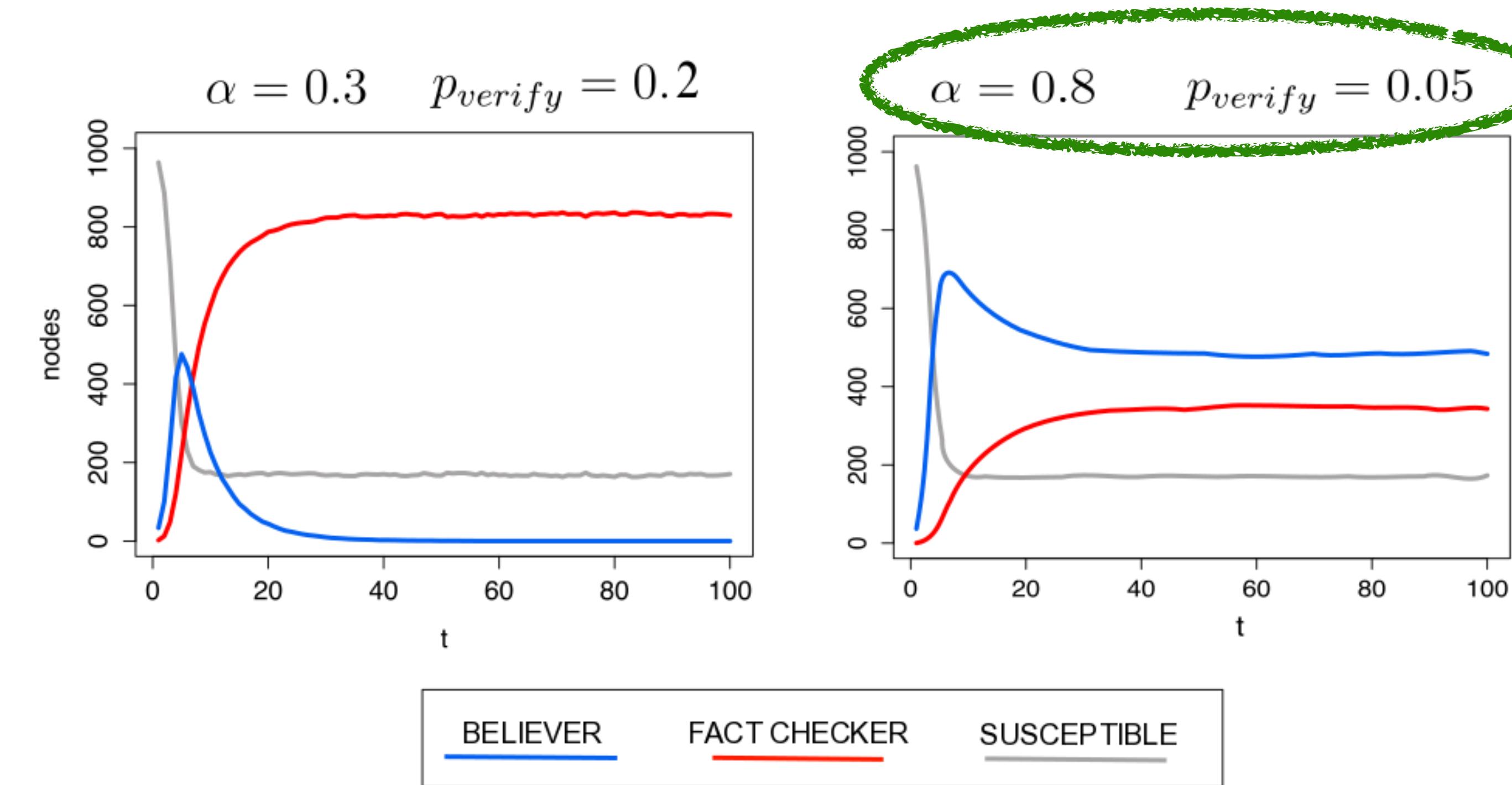
From Believer/Fact-Checker to Susceptible

Dynamics (agent-based simulations)
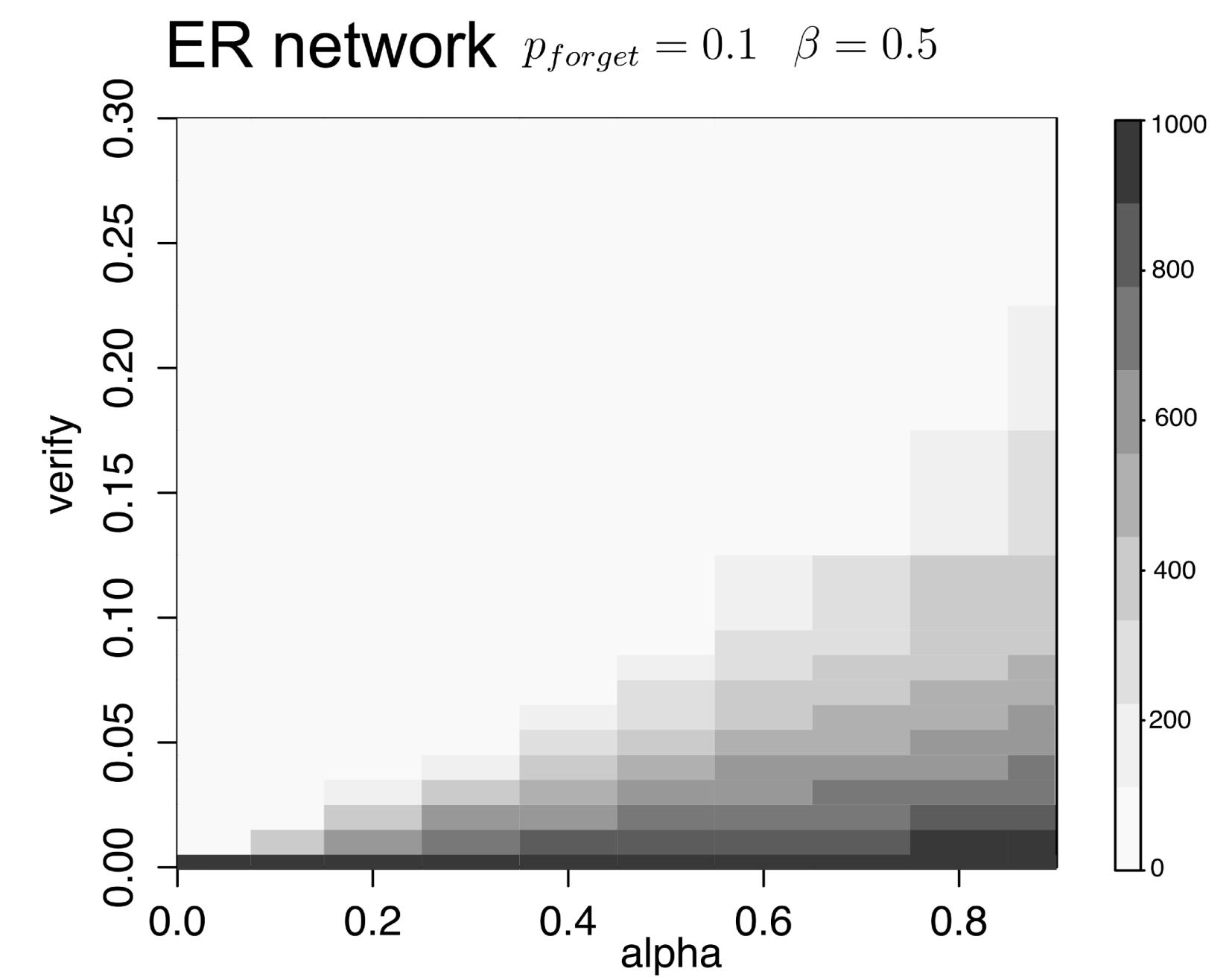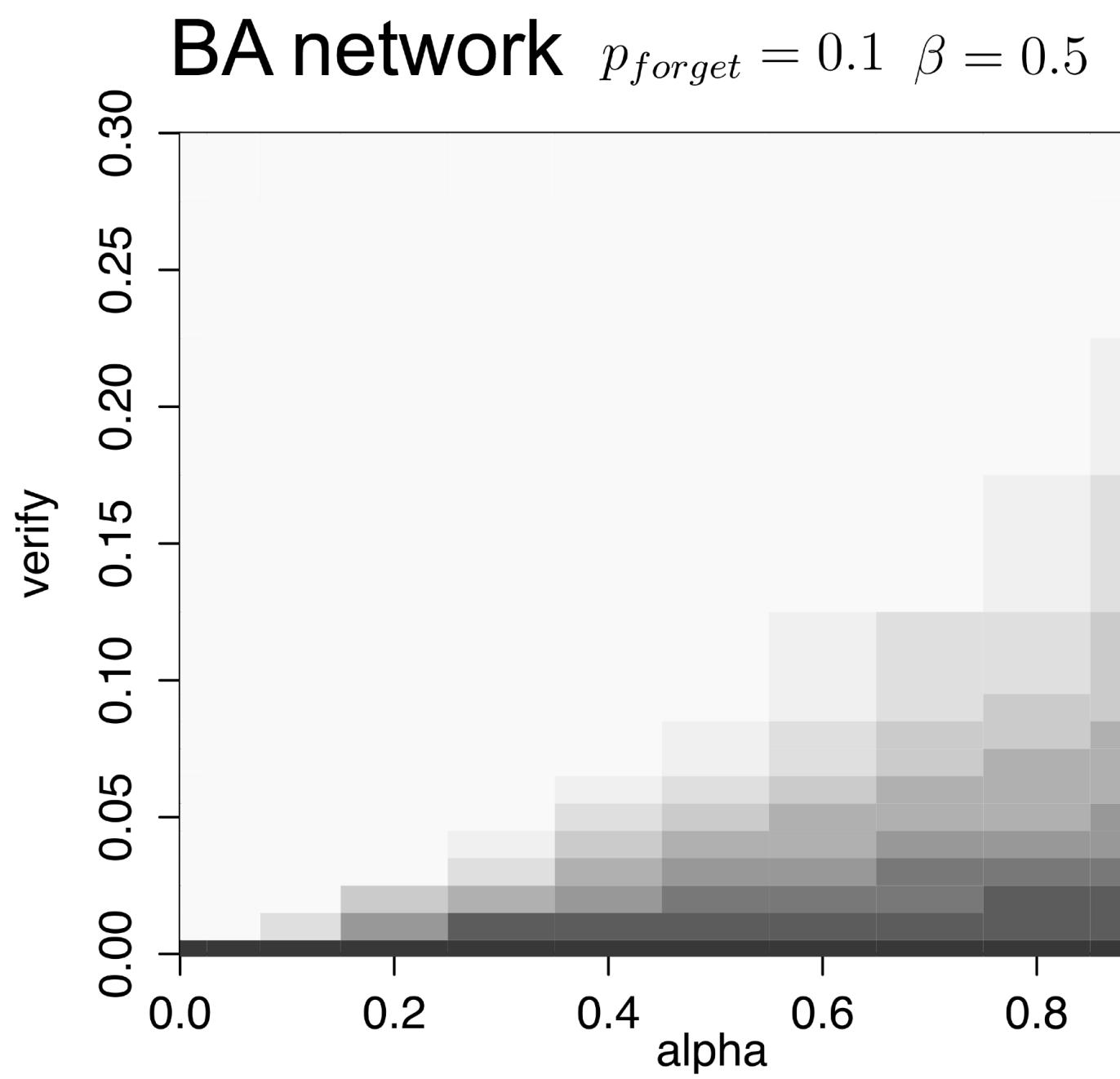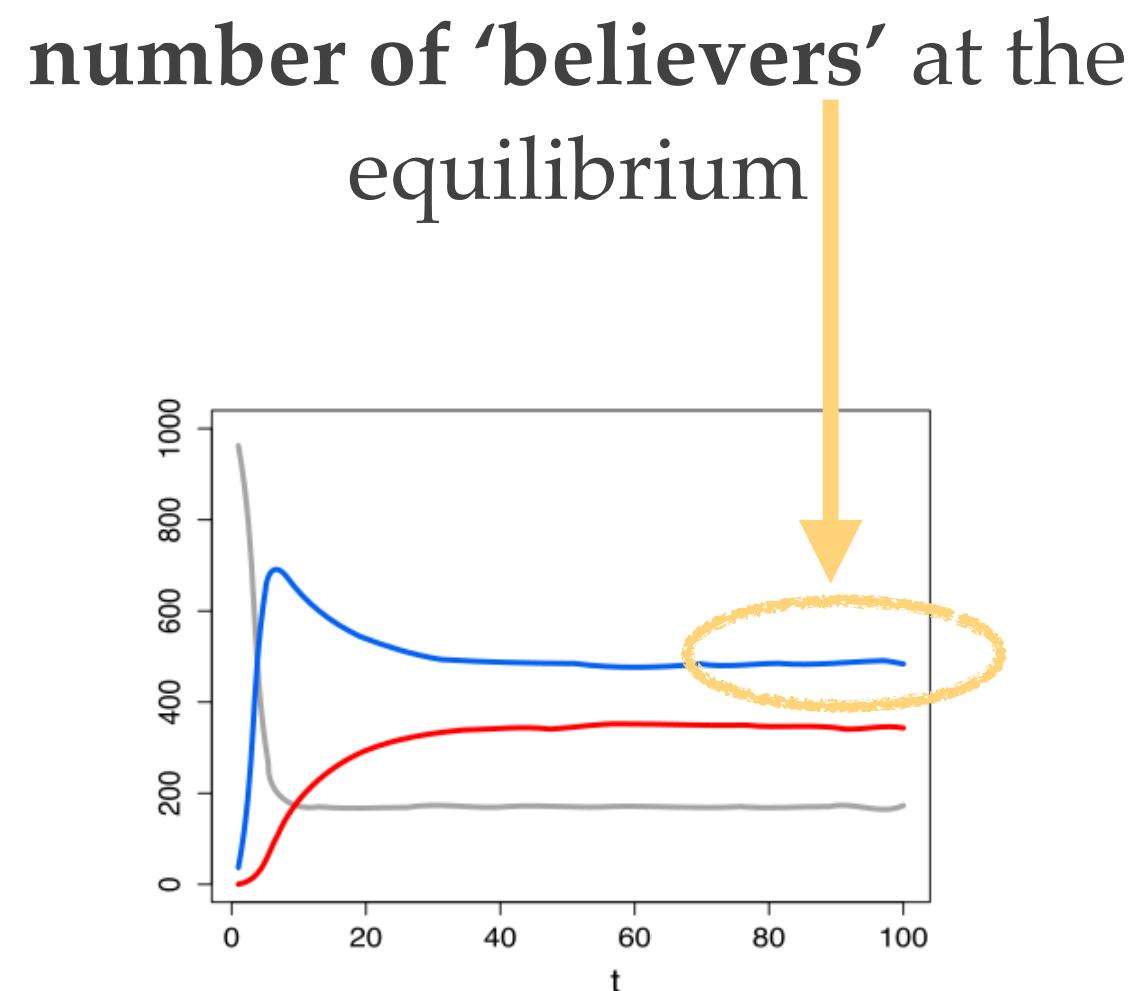
Dynamics (agent-based simulations)

hoax **credibility** and **fact-checking probability** rule hoax
persistence in the network

Dynamics (agent-based simulations)

number of 'believers' at the equilibrium

BA network $p_{forget} = 0.1$ $\beta = 0.5$

ER network $p_{forget} = 0.1$ $\beta = 0.5$
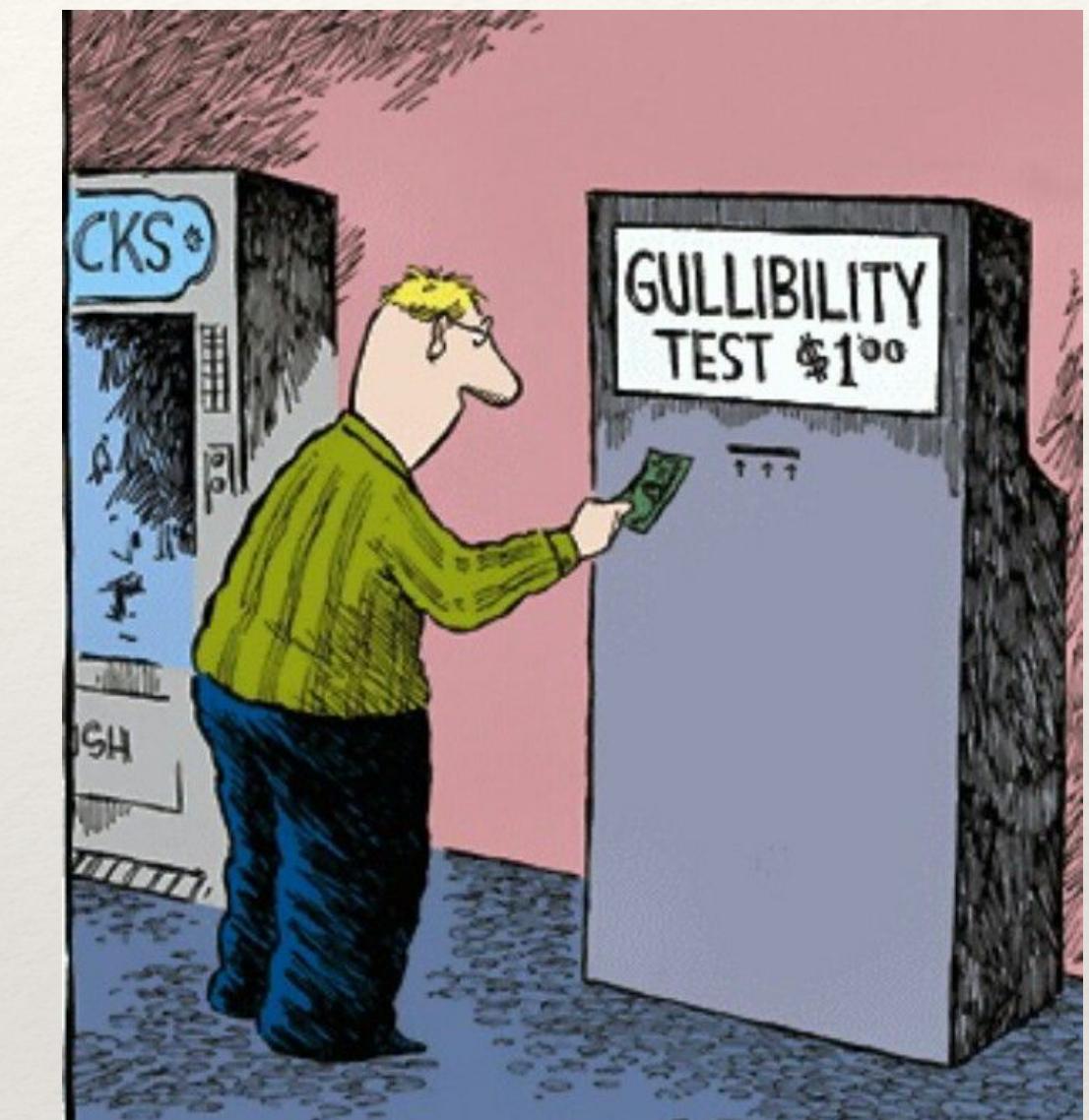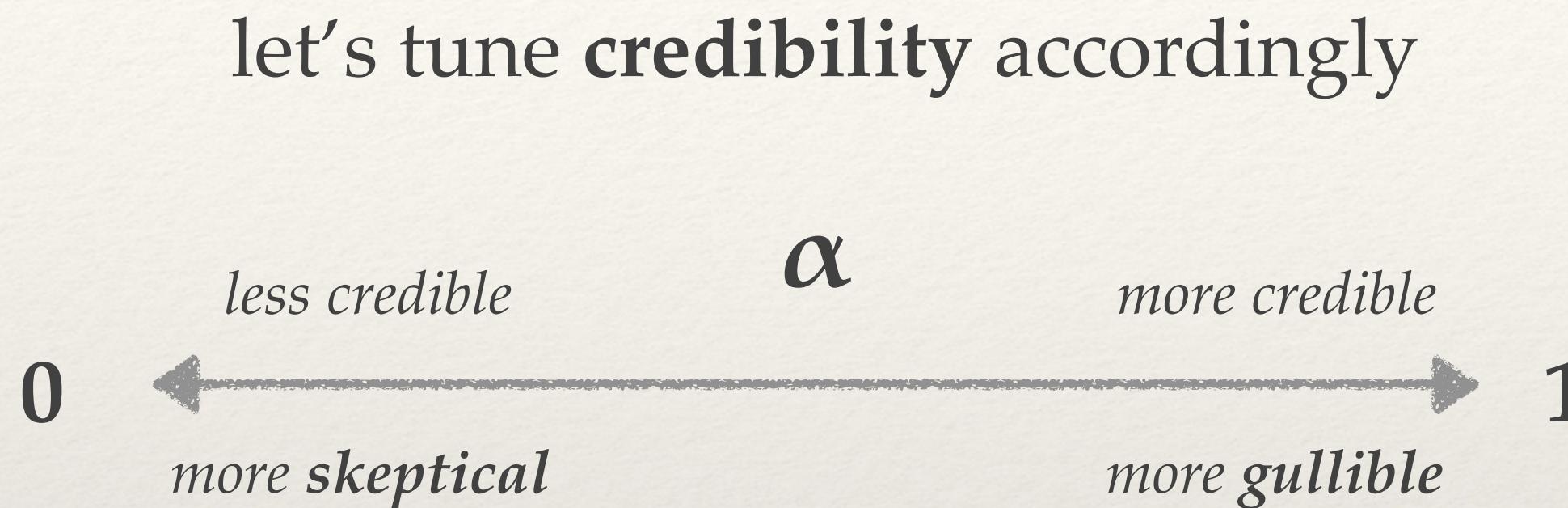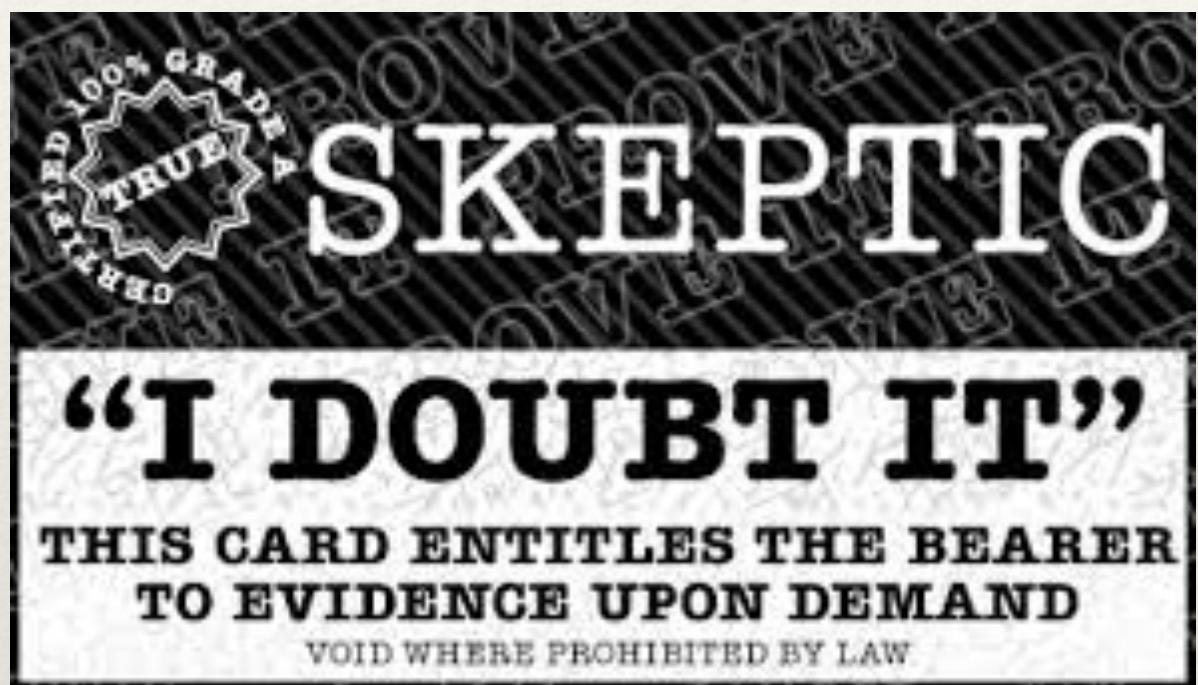
First step toward "good practices" understanding

threshold on verifying probability: our model provides an idea of how many believers we need to convince to guarantee the removal of the hoax

M Tambuscio, G Ruffo, A Flammini, and F Menczer. 2015. Fact-checking Effect on Viral Hoaxes: A Model of Misinformation Spread in Social Networks. In Proc. of the 24th Int. Conf. on World Wide Web (WWW '15 Companion)

The role of segregation

Skeptical and gullible agents

let's tune **credibility** accordingly

α

less credible   *more credible*

0 ←————————————————→ 1

more skeptical   *more gullible*

the propensity to believe is also a property of the node (**gullibility**)
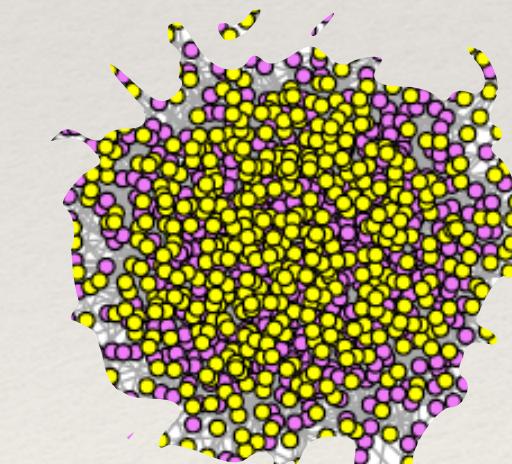
What does it happen when skeptics and gullible agents are segregated?

Modeling two segregated communities
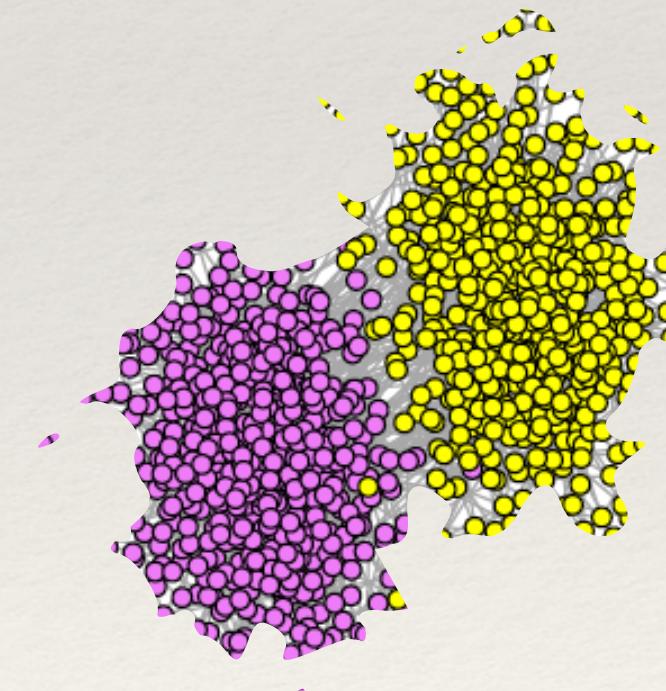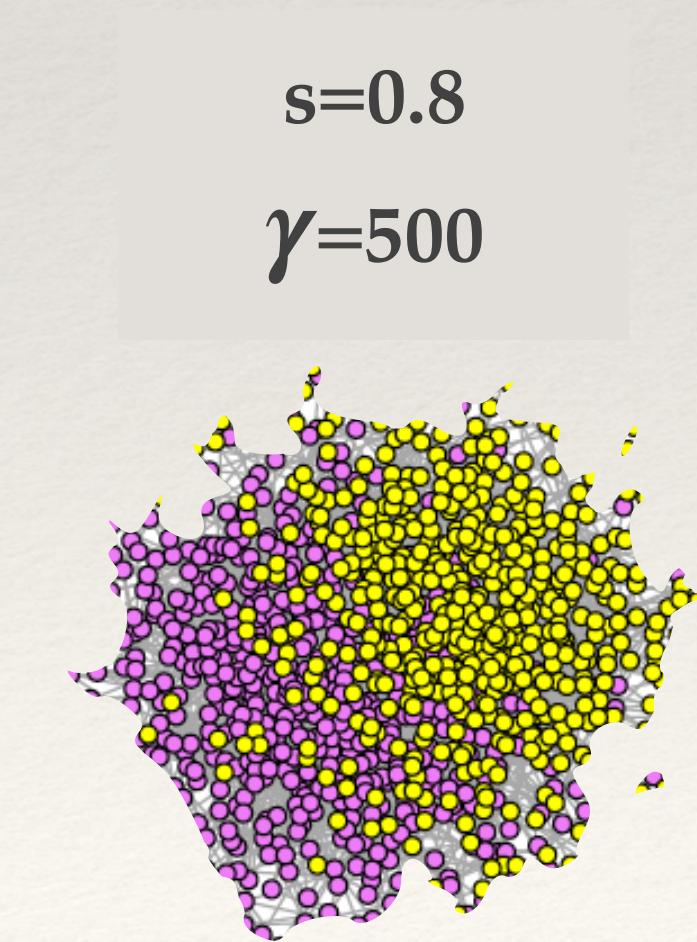
Size vs segregation

$p_f = 0.1$

LOW Forgetting Probability

Size vs segregation

$p_f = 0.1$ $\qquad\qquad\qquad$ $p_f = 0.8$

LOW Forgetting Probability $\qquad\qquad$ HIGH Forgetting Probability

gullible group size
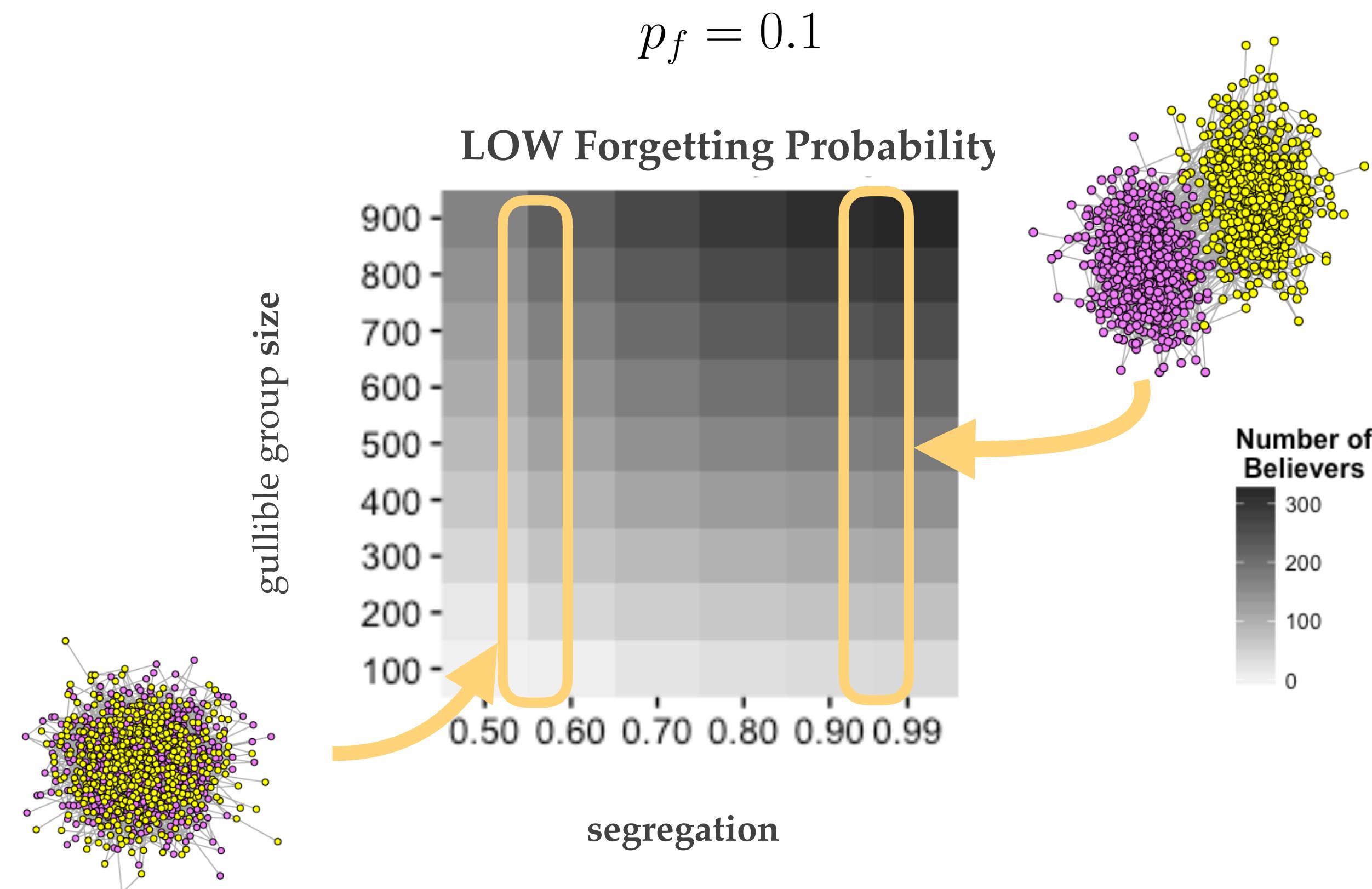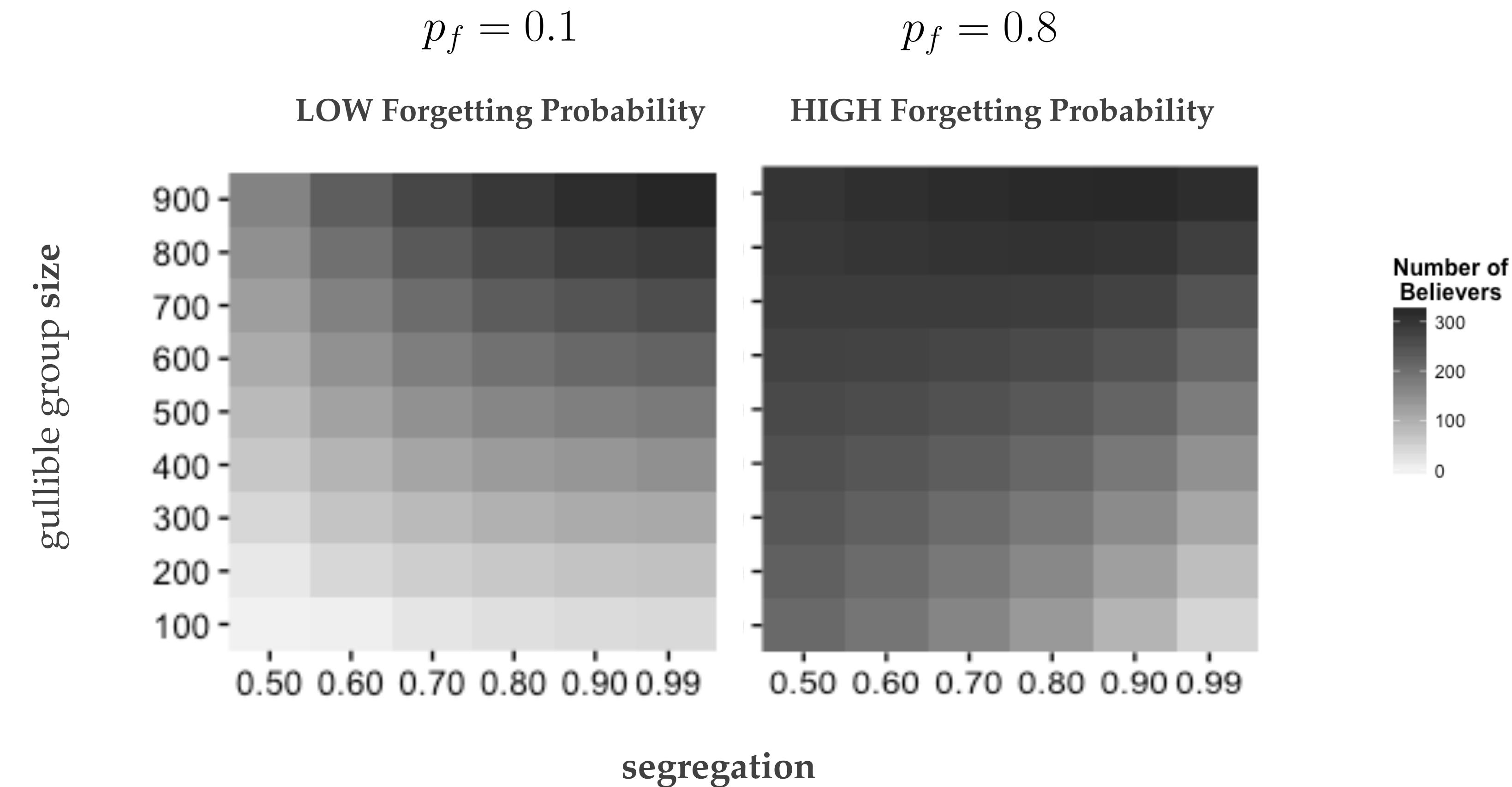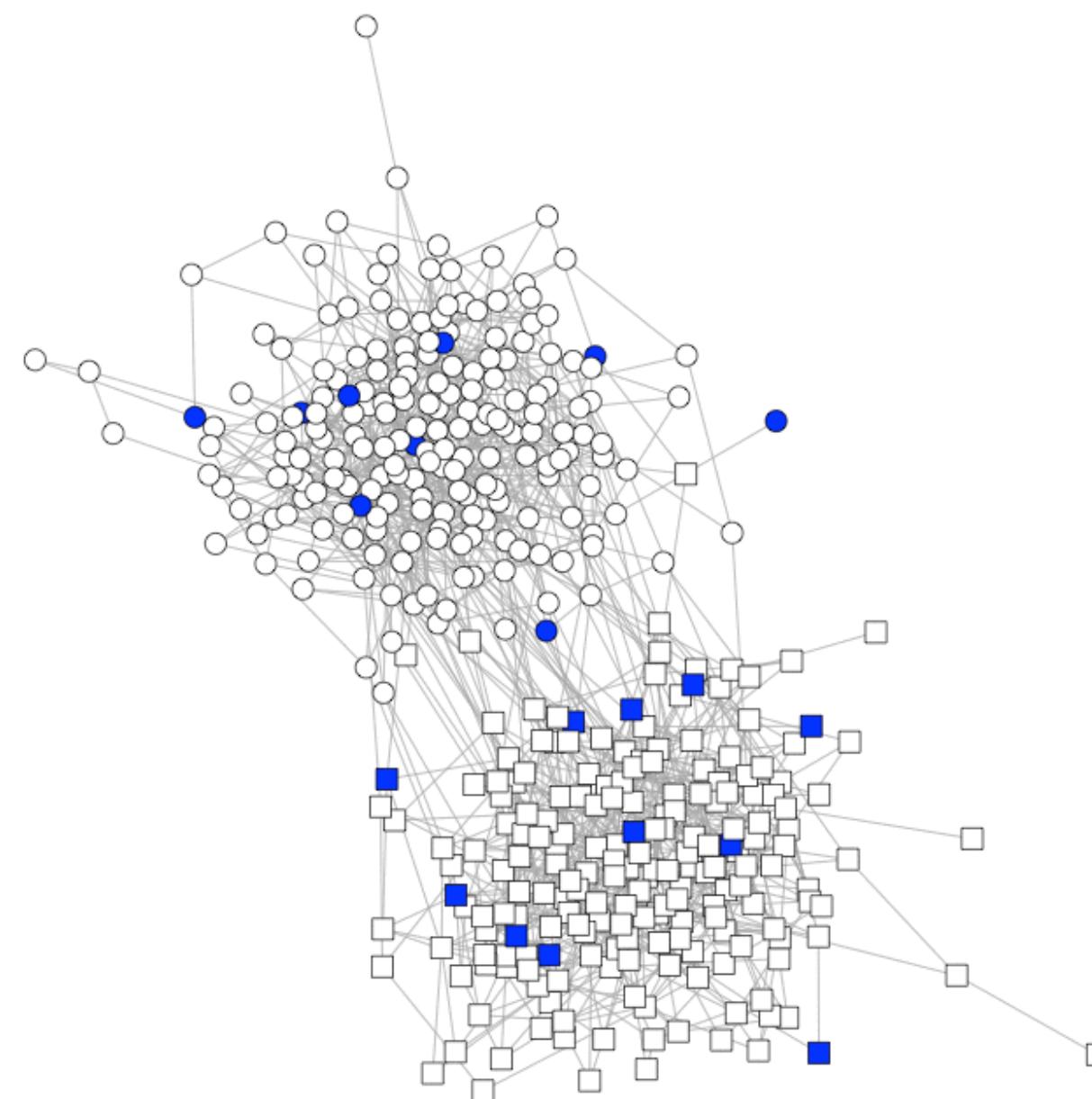
segregation

Role of forgetting

LOW Forgetting Rate
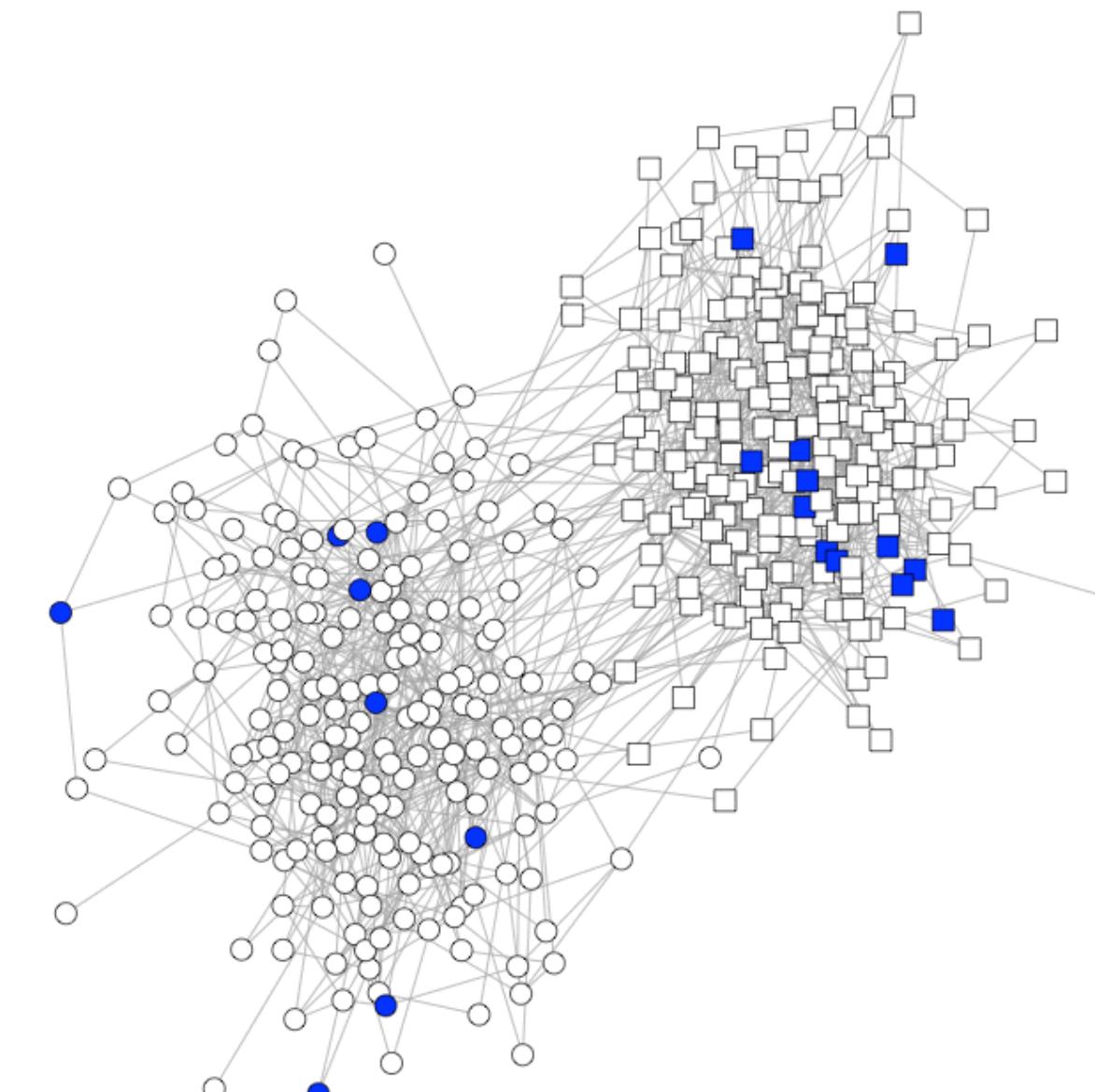
$$p_f = 0.1$$

HIGH Forgetting Rate

$$p_f = 0.8$$
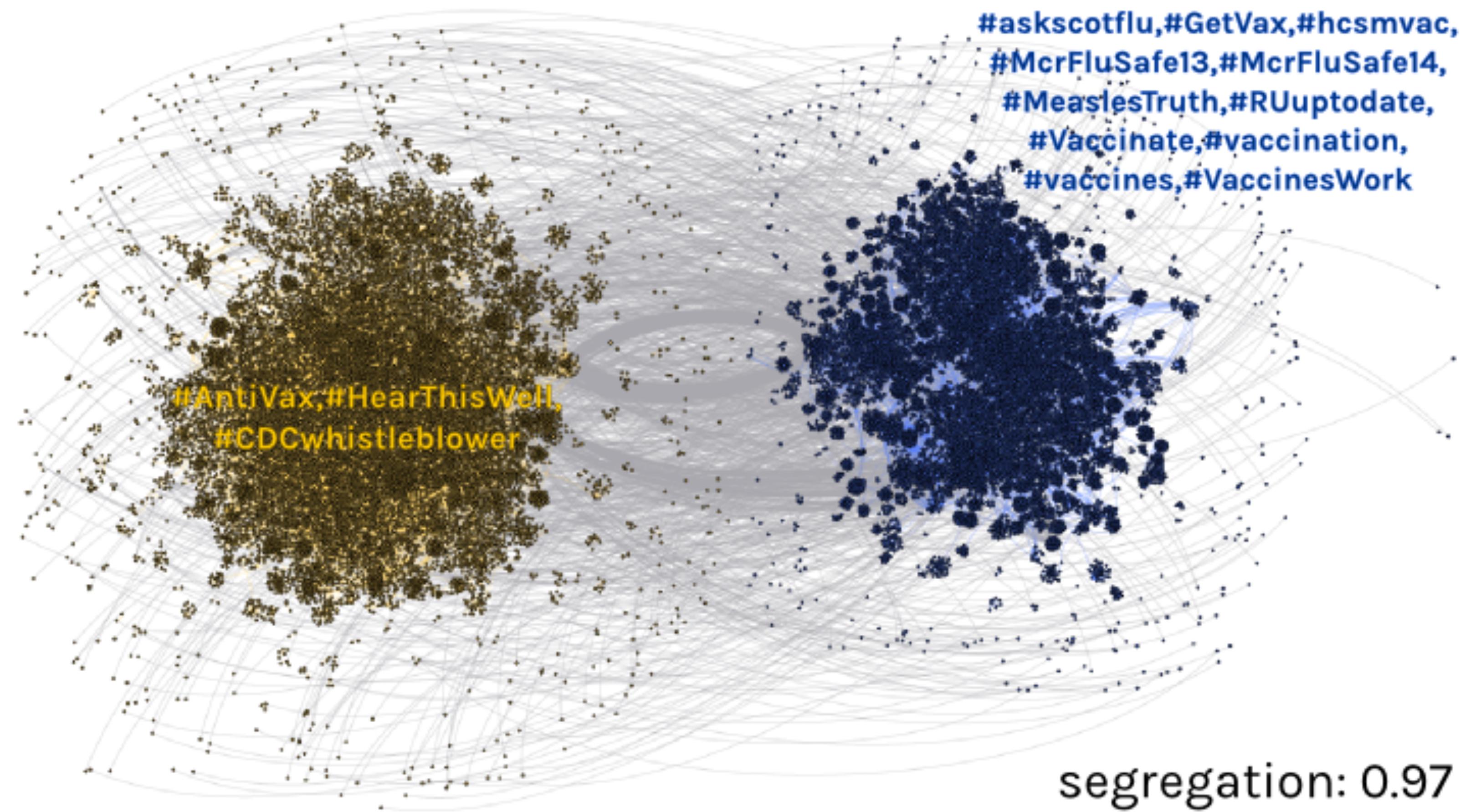
Time = 1

Time = 1

Lessons learned and observations

❖ We can use our model to study the fake-news diffusion process in **segregated community**

❖ **Complex contagion** is observed: interplay and not trivial outcomes

❖ **Forgetting** probability becomes relevant as well as the **level of segregation:**

   ❖ **high forgetting** probability (e.g., just `normal' unfounded gossip) vanishes soon in **segregated communities**

   ❖ **low forgetting** probability (e.g., conspiracy theories or partisanship beliefs) requires **low segregation**

M Tambuscio, D F M Oliveira, G L Ciampaglia, G Ruffo, Network segregation in a model of misinformation and fact-checking, Journal of Computational Social Science (2018) 1: 261.

real data: vaccines

#askscotflu,#GetVax,#hcsmvac,
#McrFluSafe13,#McrFluSafe14,
#MeaslesTruth,#RUuptodate,
#Vaccinate,#vaccination,
#vaccines,#VaccinesWork

#AntiVax,#HearThisWell,
#CDCwhistleblower

segregation: 0.97
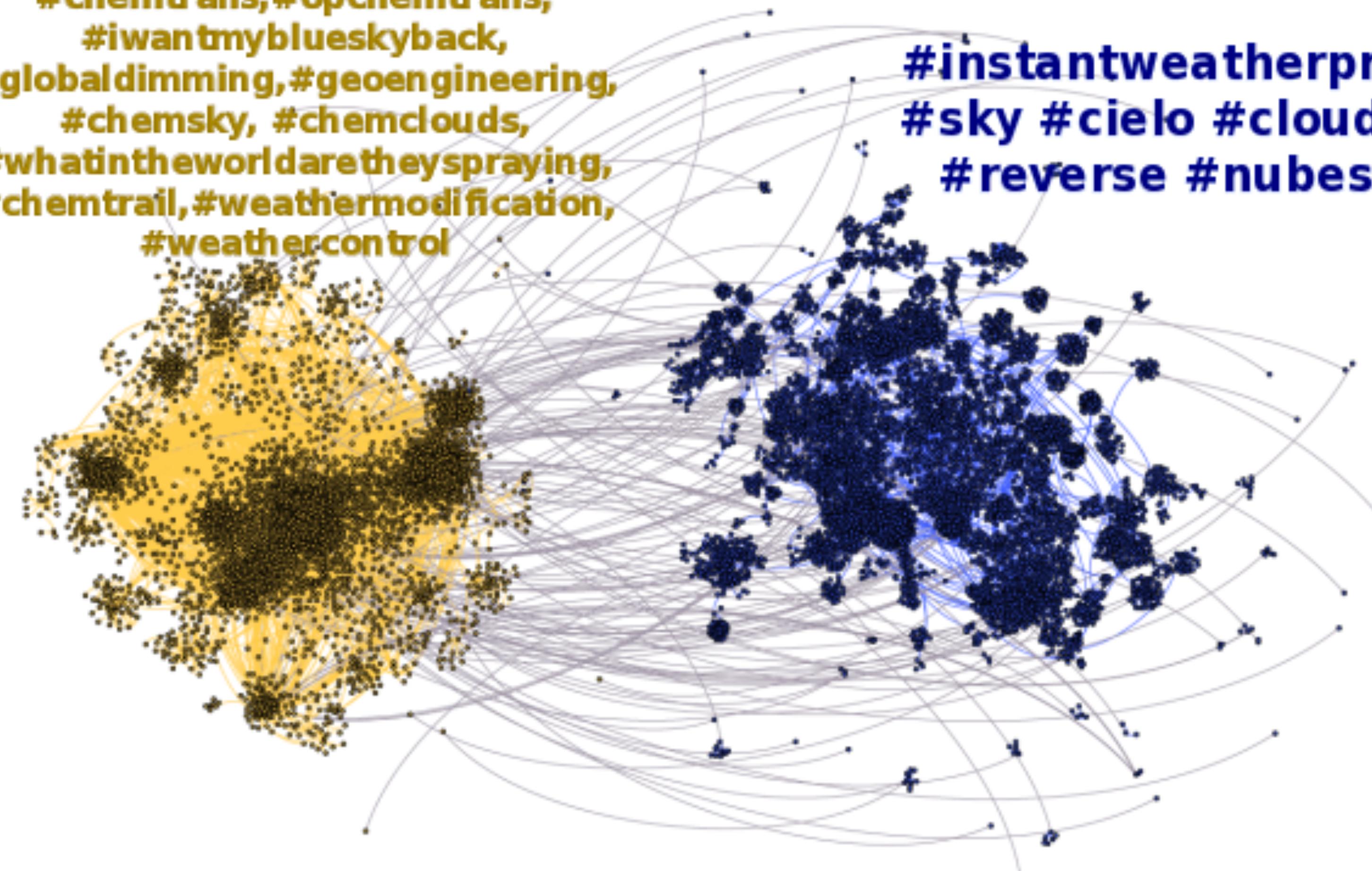
twitter data from IU https://osome.iuni.iu.edu

real data: chemtrails

#chemtrails, #opchemtrails,
#iwantmyblueskyback,
#globaldimming, #geoengineering,
#chemsky, #chemclouds,
#whatintheworldaretheyspraying,
#chemtrail, #weathermodification,
#weathercontrol

#instantweatherpro
#sky #cielo #clouds
#reverse #nubes

twitter data from IU https://osome.iuni.iu.edu

segregation: 0.99

Evaluating debunking strategies

What-if analysis

❖ We live in a **segregated** society: let's accept it!

❖ Misinformation can survive in the network for a long time: **low forgetting** probability

❖ **Computational epidemiology**: immunization works better if some node in the network (e.g., hubs, bridges) is vaccinated first

❖ **Where** to place fact-checkers?

❖ Stronger hypothesis: a believer do not verify ($p_{verify} = 0$)

 ❖ they can still forget

 ❖ we can accept to leave half of the population in their own (false) beliefs, but we want at least to protect the skeptics!

Basic settings with no verification

Setting

segregation: 0.92 (high)

forgetting: 0.1 (low)

gullible group:

- α: 0.8
- seeders B: 10%
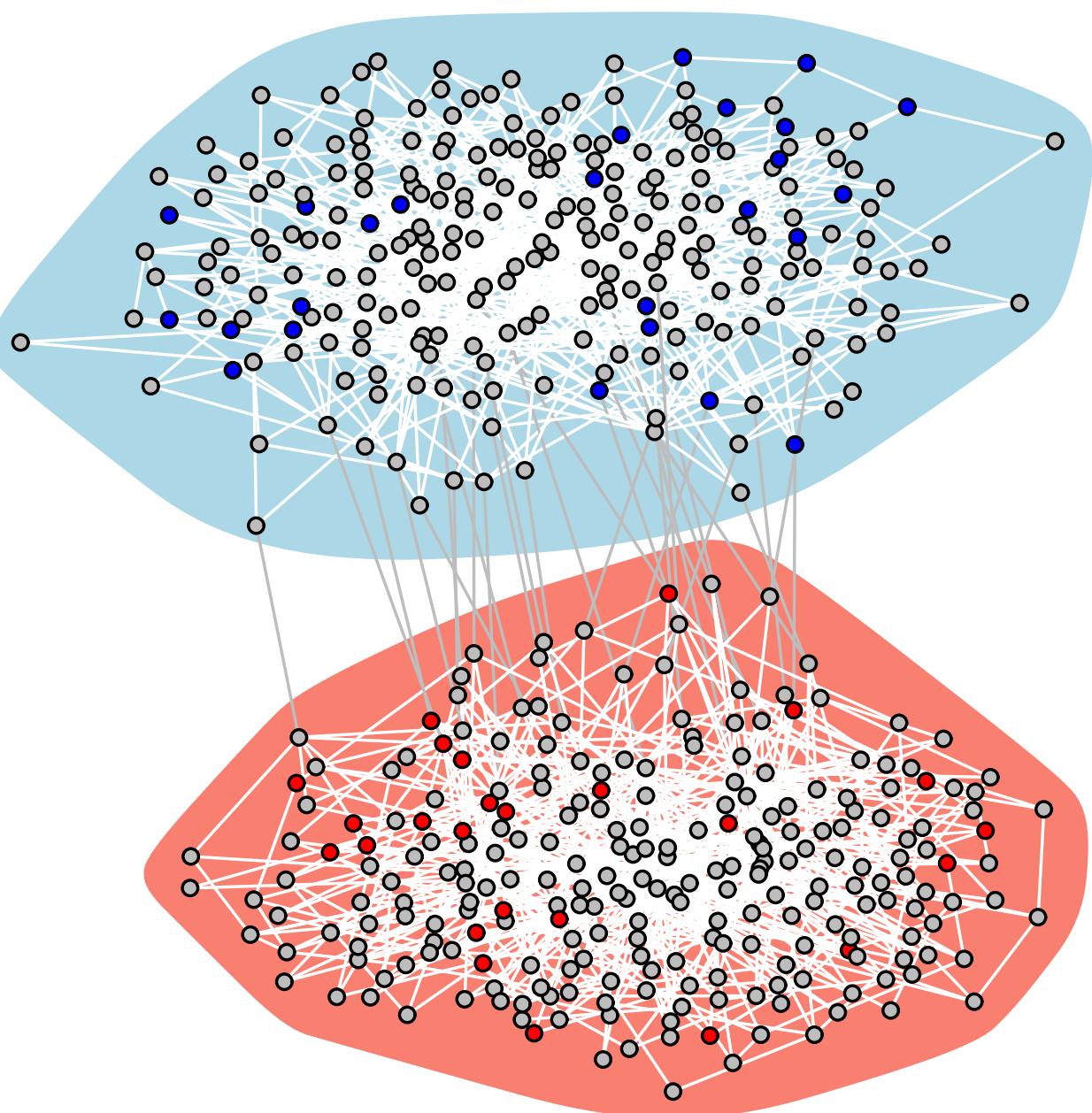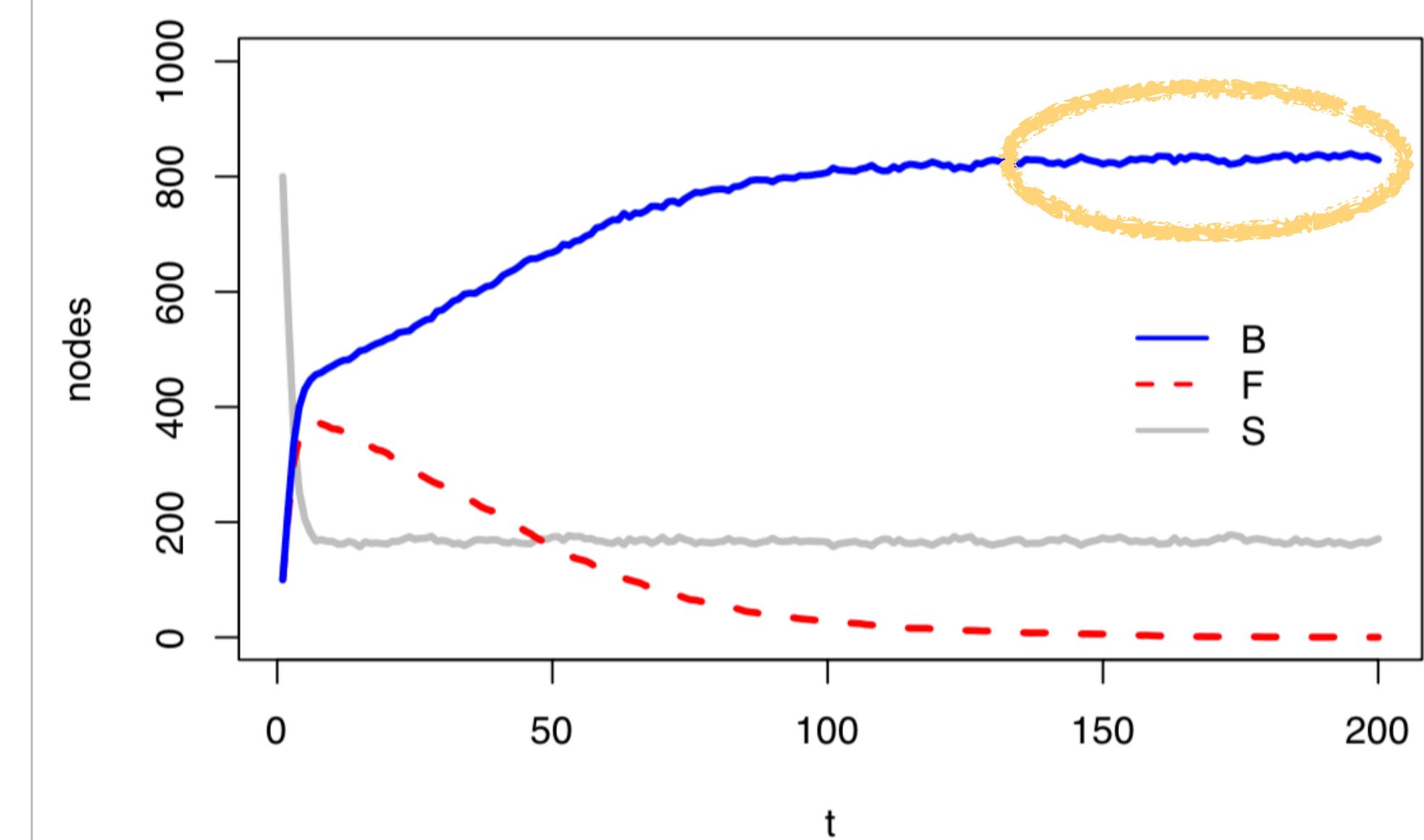
skeptical group:

- α: 0.3
- seeders FC: 10%

Simulation start

Simulation results

As expected: very **bad!**

Eternal fact-checkers placed at random

Setting

segregation: 0.92 (high)

forgetting: 0.1 (low)

gullible group:

- α: 0.8
- seeders B: 10%
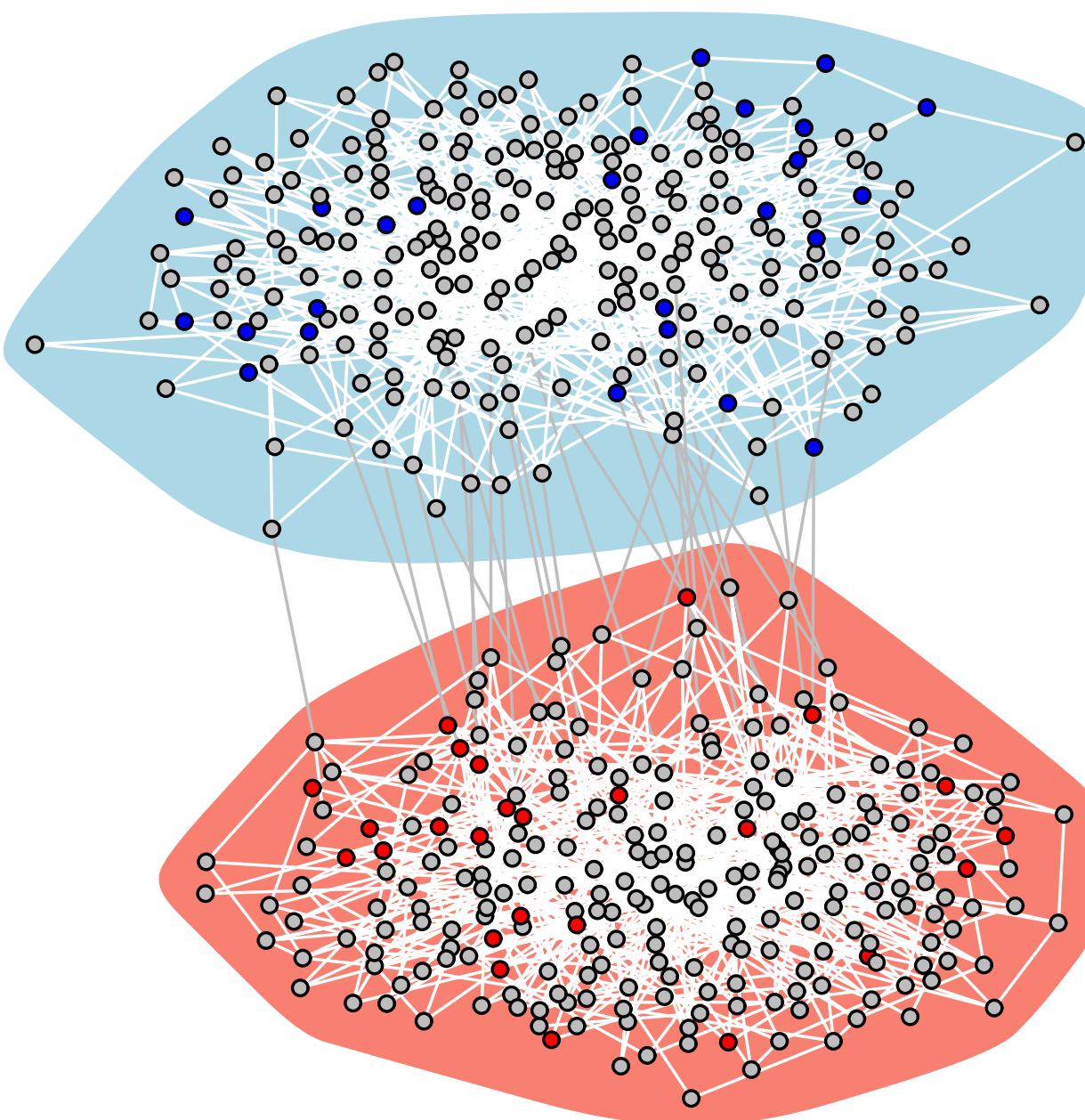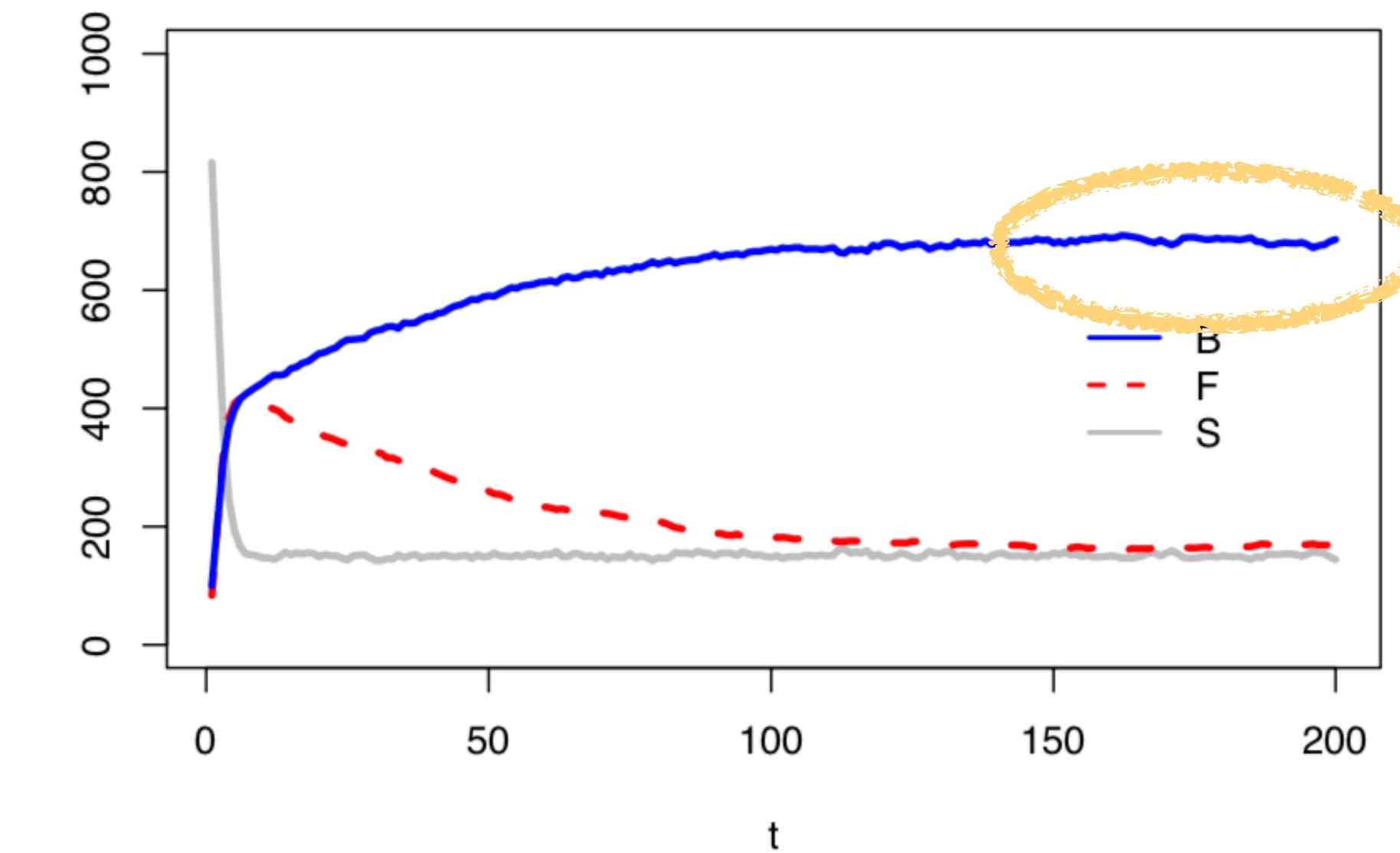
skeptical group:

- α: 0.3
- seeders FC: 10%
- **seeders are eFC**

Simulation start

Simulation results

better, but still…

Hubs as eternal fact-checkers

Setting

segregation: 0.92 (high)

forgetting: 0.1 (low)

gullible group:

- α: 0.8
- seeders B: 10%
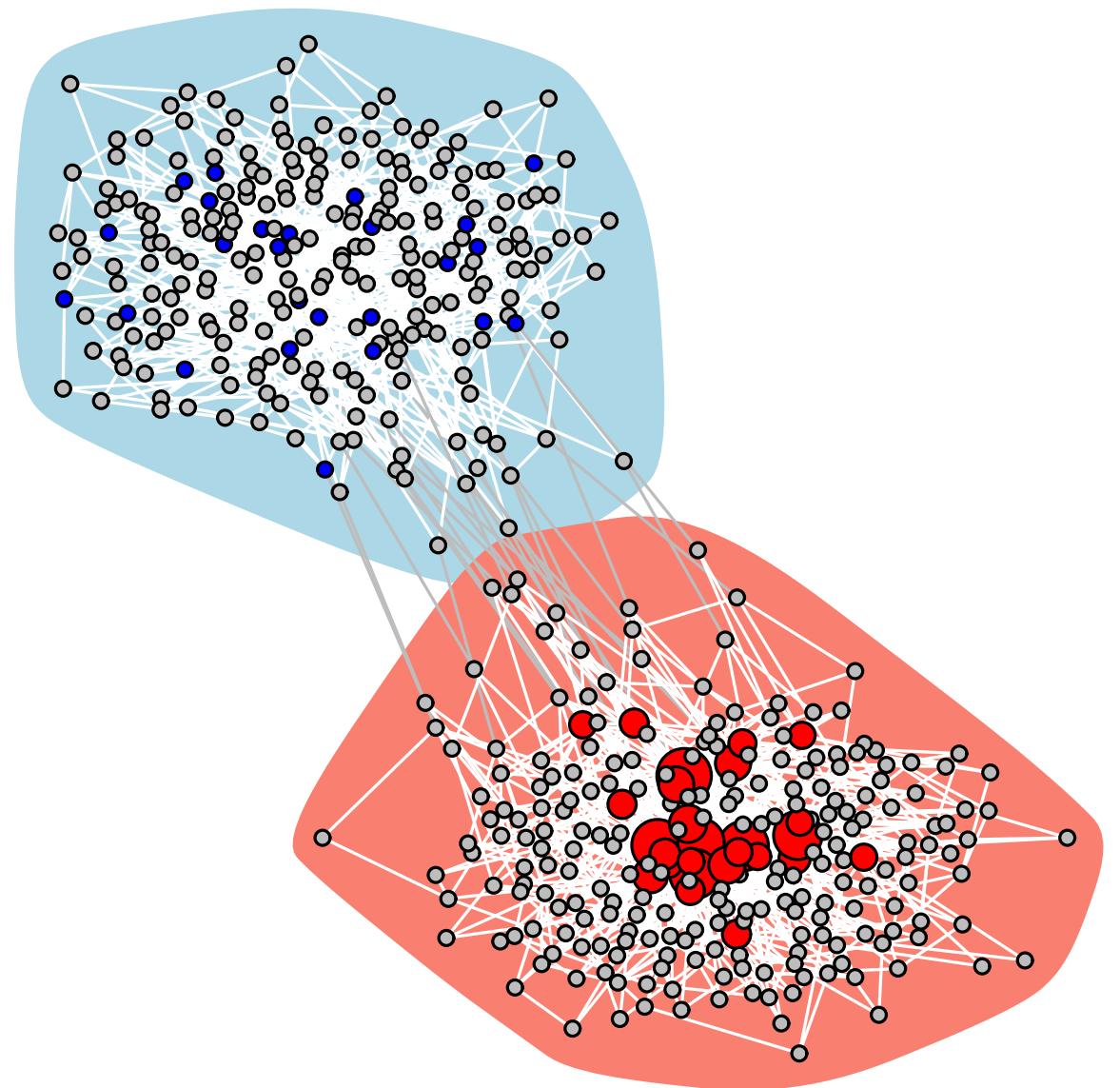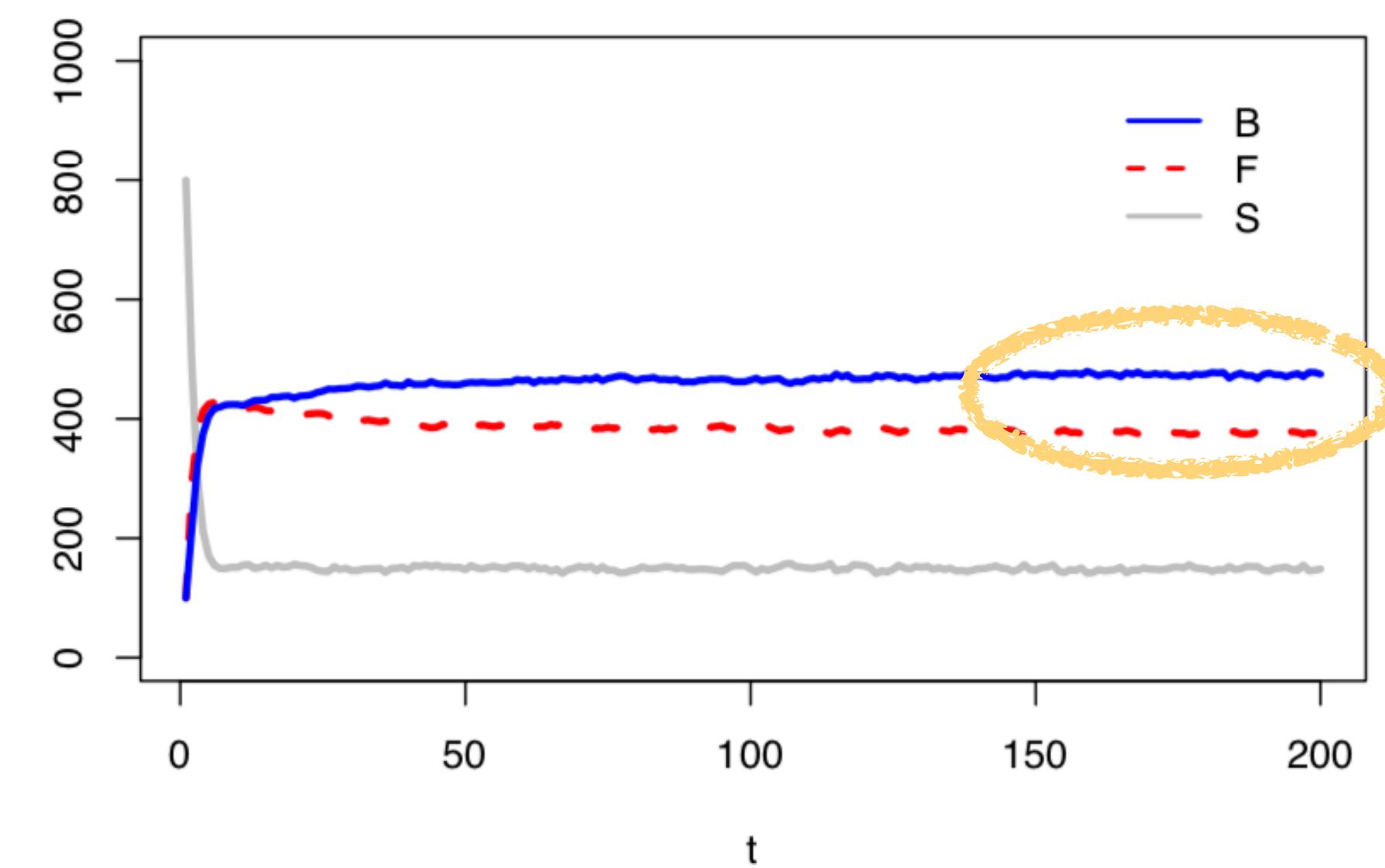
skeptical group:

- α: 0.3
- seeders FC: 10%
- **HUBS are eFC!**

Simulation start

Simulation results

better

Bridges as eternal fact-checker

Setting

segregation: 0.92 (high)

forgetting: 0.1 (low)

gullible group:

- α: 0.8
- seeders B: 10%
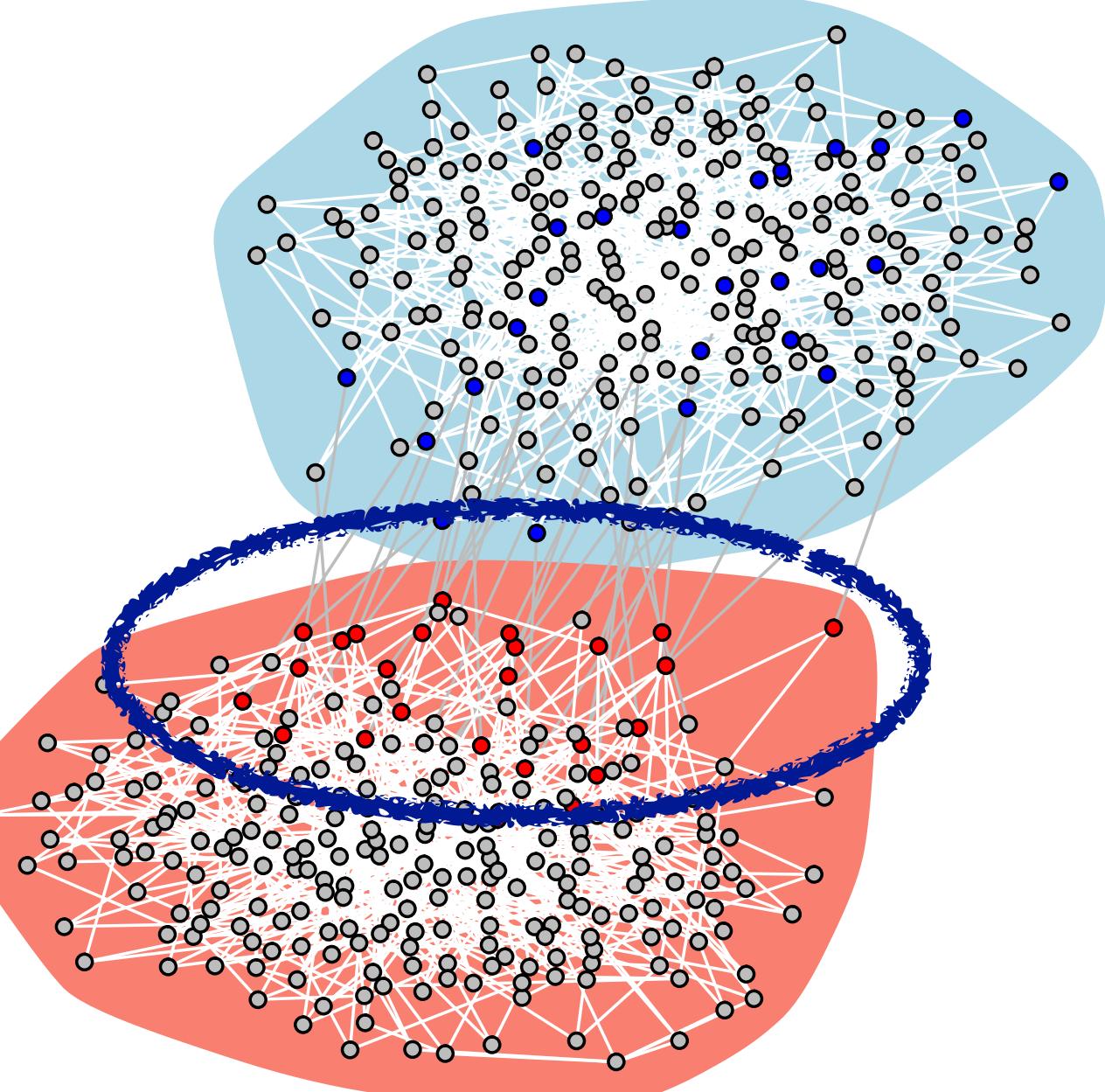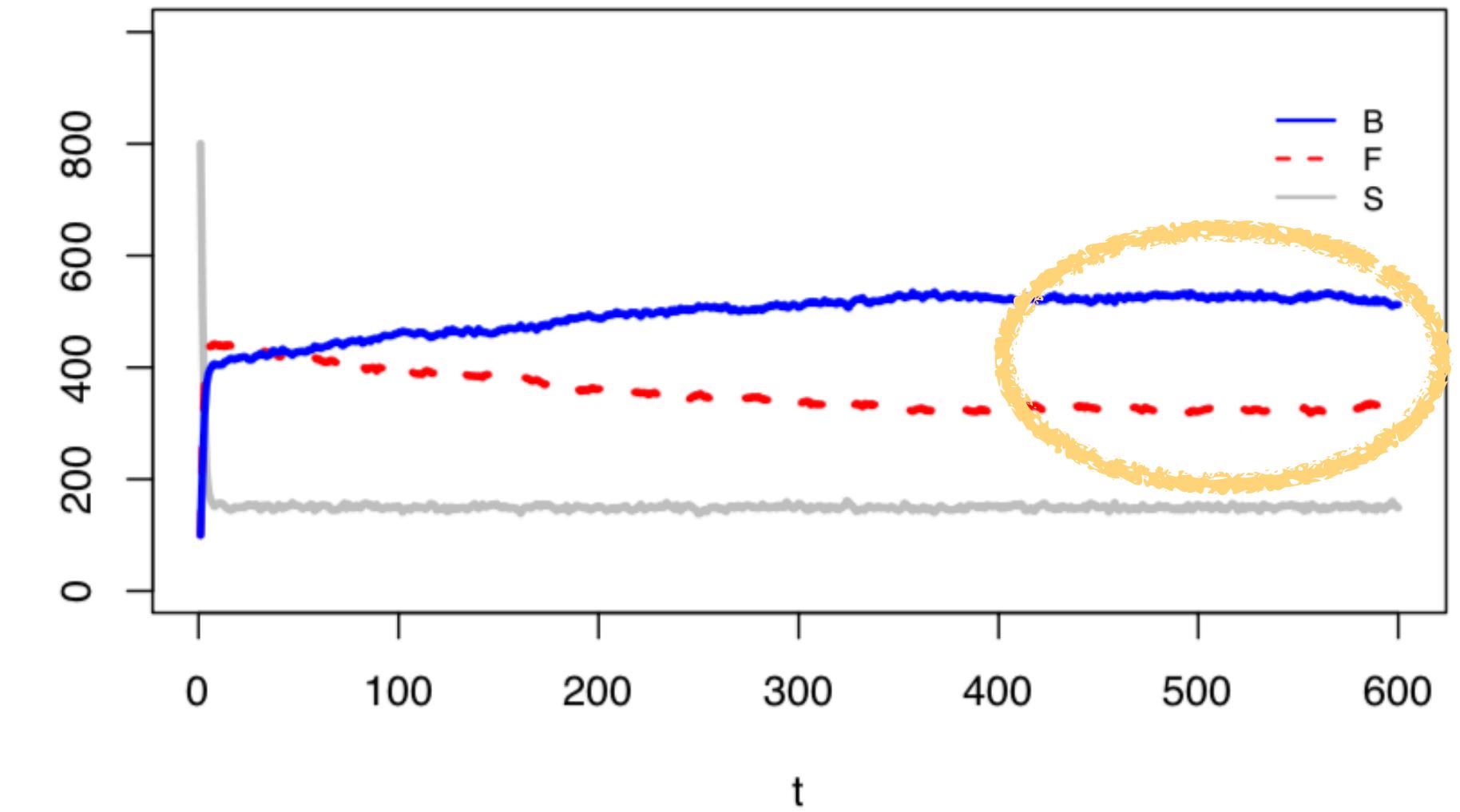
skeptical group:

- α: 0.3
- seeders FC: 10%
- **BRIDGES are eFC!**

Simulation start

Simulation results

comparable, more realistic

Lessons learned and observations

❖ **Debunking activism** is often considered useless or **counterproductive**

❖ However, a world without fact-checking is harmless against fake-news circulation: **skeptics exposed to misinformation** will turn into **believers** because of **social influence**

❖ **Skeptics with links to gullible subjects** should be the first to be exposed to the fact-checking: misinformation will survive in the network, but their communities can be 'protected' by such **gatekeepers**

❖ Note: no socio-psychological assumption so far. Real world is much more complicated

M Tambuscio, G. Ruffo, Fact-checking strategies to limit urban legends spreading in a segregated society, in Applied Network Science 4, 116 (2019), Springer, https://appliednetsci.springeropen.com/articles/10.1007/s41109-019-0233-1

protect the vulnerable, encourage skepticism

Who is the gatekeeper?

Finland is reported as winning the war against fake news in the classrooms: **education** first

Teachers and the education system have a great **responsibility**

SPECIAL REPORT

Finland is winning the war on fake news. What it's learned may be crucial to Western democracy

By Eliza Mackintosh, CNN
Video by Edward Kiernan, CNN

Helsinki, Finland (CNN) – On a recent afternoon in Helsinki, a group of students gathered to hear a lecture on a subject that is far from a staple in most community college curriculums.

Standing in front of the classroom at Espoo Adult Education Centre, Jussi Toivanen worked his way through his PowerPoint presentation. A slide titled "Have you been hit by the Russian troll army?" included a checklist of methods used to deceive readers on social media: image and video manipulations, half-truths, intimidation and false profiles.

Discussion and conclusions

Recap

❖ **Structural segregation** may be one of the main triggers of opinion **polarization**

❖ **Fake-news spreading,** especially when partisanship and antagonistic behavior reinforce the debate, is **facilitated** in segregated networks

❖ Fact-checking is needed and skeptics with links to more gullible (vulnerable) contacts can be recruited as **gatekeepers**

❖ Beware of the **interplay**: segregation causes polarization and vice-versa
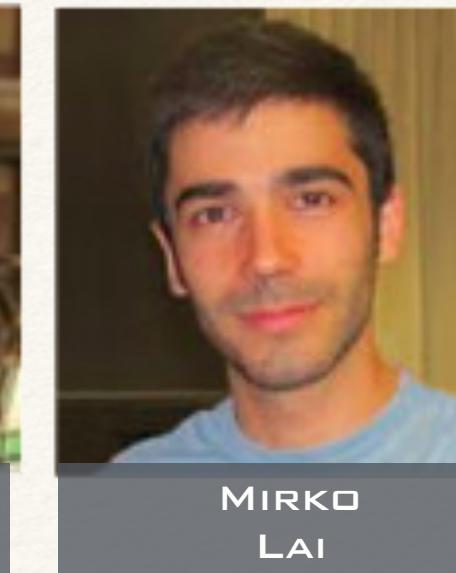
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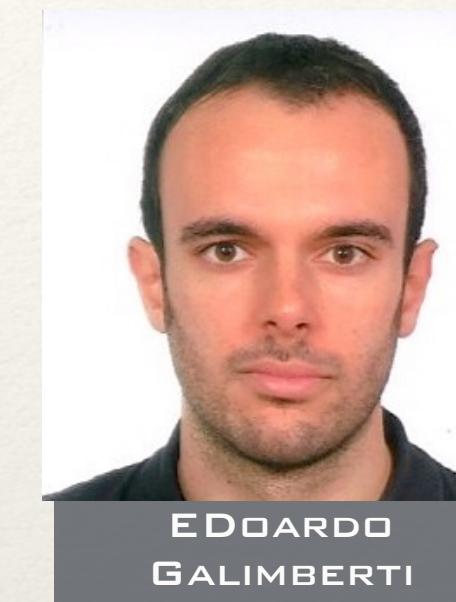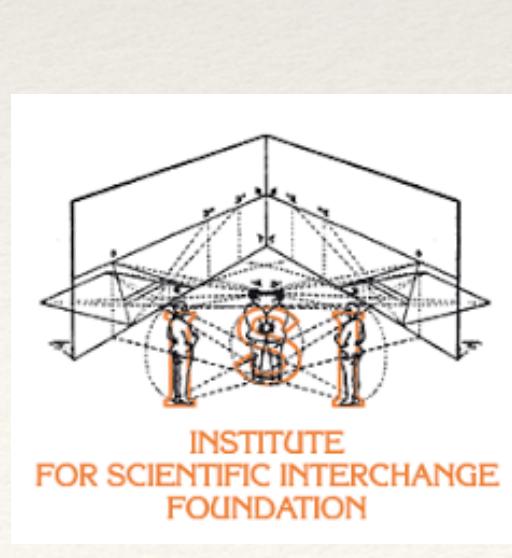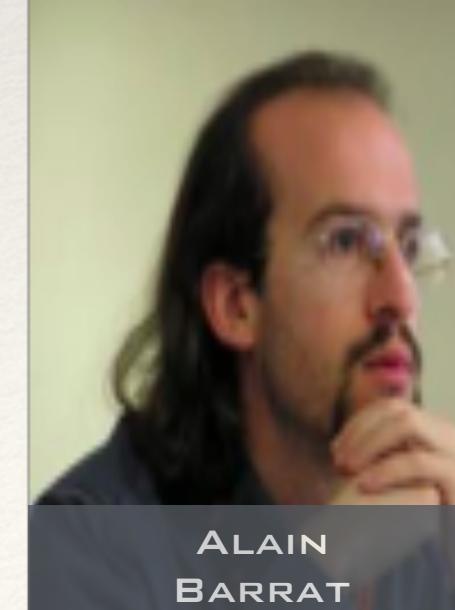
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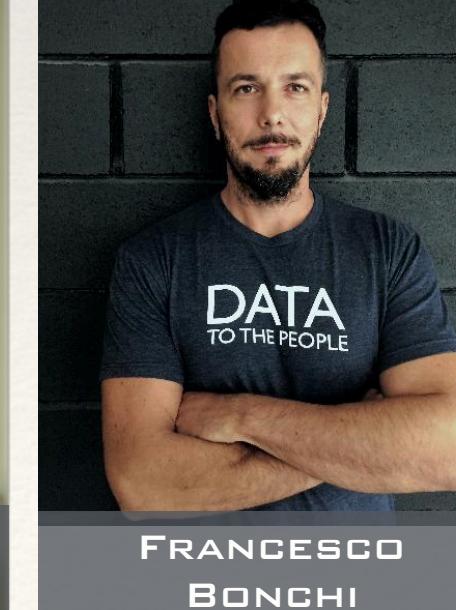
http://www.di.unito.it/~ruffo/talks/2019_Oct_NEU.pdf

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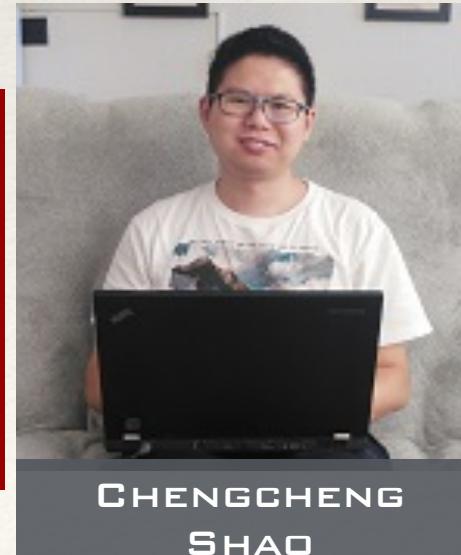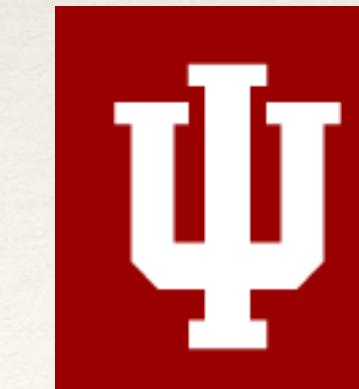
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