Truth and Conformity on Social Networks

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Public Discourse

Which social policy leads to better outcomes?

Which political candidate is more qualified?

Conformity Bias

Cf. Ash (1955); Irving (1982); Esser & Joanne (1989); Browning (2005); and Solomon (2014).

Network Epistemology

Zollman (2010)

Epistemic Benefit of Transient Diversity

Erkenn (2010) 72:17–35
DOI 10.1007/s10670-009-9194-6

ORIGINAL ARTICLE

The Epistemic Benefit of Transient Diversity

Kevin J. S. Zollman

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Abstract There is growing interest in understanding and eliciting div
within groups of scientists. This paper illustrates the need for this div
through a historical example, and a formal model is presented to
situations of this type. Analysis of this model reveals that a divisior
be maintained in two different ways: by limiting information or
the scientists with extreme beliefs. If both features are present howe
diversity is maintained indefinitely, and as a result agents fail to co
truth. Beyond the mechanisms for creating diversity suggested here, t
the real epistemic goal is not diversity but transient diversity.

A striking social feature of science is the extensive division of labor.
different scientists pursuing different problems, but even those workin
problem will pursue different solutions to that problem. This dive
applauded because, in many circumstances one can simply not determ
a general theoretical or methodological approach will succeed
attempting to apply it, study the effects of its application, and deve
auxiliary theories to assist in its application.[1]

The value of diversity presents a problem for more traditional
scientific methodology, since if everyone employs the same standards

Zollman (2013)

Network Epistemology

Philosophy Compass 8/1 (2013): 15–27, 10.1111/j.1747-9991.2012.00534.x

Network Epistemology: Communication in Epistemic Communities

Kevin J.S. Zollman*
Carnegie Mellon University

Abstract

Much of contemporary knowledge is generated by groups not single individuals. A natural question to ask is, what features make groups better or worse at generating knowledge? This paper surveys research that spans several disciplines which focuses on one aspect of epistemic communities: the way they communicate internally. This research has revealed that a wide number of different communication structures are best, but what is best in a given situation depends on particular details of the problem being confronted by the group.

1. Introduction

Traditional epistemologists often assume a very simple model of knowledge acquisition. There is an individual inquirer who receives data from the world. Rarely does this data explicitly include other inquirers. If other individuals are included in the data they are treated as on a par with all other sorts of data. The now burgeoning field of social epistemology departs from this model. Its first, and probably most popular, departure incorporates other inquirers as different (potential) sources of knowledge. Doing so opens up many questions. How should one react to another inquirer who holds different beliefs? What is the epistemic ground for knowledge that comes exclusively from another inquirer? If two inquirers disagree, who should you trust? Etc.

This first departure retains the traditional focus on an individual inquirer but represents the inquirer's data as taking two different forms: data from the world and data from another inquirer. Scholars then ask whether these two are, in fact, different, and if so what epistemic norms govern the later.

There is a yet more radical departure that focuses not on an individual agent, but instead considers a group of inquirers as the unit of analysis (Goldman 2011). With the group as epistemic agent, one can now ask questions like what properties of groups make them better or worse epistemic groups? This question is important as much of our collective knowledge is generated by groups, not single individual inquirers. Juries decide guilt or innocence. Corporations must form something like beliefs so that they can make decisions for which they are (all too rarely) held liable. Science is increasingly becoming the collective endeavor of many individual scientists.

One might be inclined to conflate these two levels of analysis. Surely the best groups

Network Epistemology

Schneider, Rubin, O'Connor (2018)

Promoting Diverse Collaborations

Heesen (2017)

Academic Superstars

Mayo-Wilson (2014)

Reliability of Testimonial Norms

THE PHILOSOPHY OF SCIENCE ASSOCIATION

Promoting Diverse Collaborations

Mike D Schneider, Hannah Rubin, and Cailin O'Connor

Abstract

Philosophers of science and social scientists have argued that diverse perspectives, methods, and background assumptions are critical to the progress of science. One way to achieve such diversity is to ensure that a scientific community is made up of individuals from diverse personal backgrounds. In many scientific disciplines, though, minority groups are underrepresented. In some cases minority members further segregate into sub-fields, thus decreasing the effective diversity of research collaborations. In this paper, we employ agent-based, game theoretic models to investigate various types of initiatives aimed at improving the diversity of collaborative groups. This formal framework provides a platform to discuss the potential efficacy of these various proposals. As we point out, though, such proposals may have unintended negative consequences.

1 Introduction

Philosophers of science and social scientists have argued that diversity in scientific communities is critical to the progress of science, and have explored initiatives that might help diversify science. However, there has been much less work done on promoting diversity in collaborative teams, where scientists are actually interacting and working with those unlike themselves. Rubin and O'Connor [working paper] use evolutionary game theoretic models to show that when members of one social group tend to get more credit for collaborative endeavors this can disincentivize collaboration between groups, leading individuals to mostly collaborate with those like them. This sort of process can negatively impact the progress of science whenever collaboration benefits from diversity.

In this paper, we use a similar evolutionary framework to explore the conditions which promote diverse collaborations in scientific disciplines. In particular, we employ agent-based, game theoretic models of actors in collaboration networks to test how discriminatory norms interact with individual decisions to

Synthese (2017) 194:4499–4518
DOI 10.1007/s11229-016-1146-5

Academic superstars: competent or lucky?

Remco Heesen[1,2]

Received: 10 September 2015 / Accepted: 15 June 2016 / Published online: 24 Septem

Abstract I show that the social stratification of academic science can
of academics' preference for reading work of high epistemic value. Th
with a view on which academic superstars are highly competent acad
with a view on which superstars arise primarily due to luck. I argue th
is beneficial if most superstars are competent, but not if most superst
also argue that it is impossible to tell whether most superstars are in fa
lucky, or which group a given superstar belongs to, and hence wheth
is overall beneficial.

Keywords Philosophy of science · Social structure of science · Formal

Synthese (2014) 191:55–78
DOI 10.1007/s11229-013-0320-2

Reliability of testimonial norms in scientific communities

Conor Mayo-Wilson

Received: 6 July 2012 / Accepted: 17 July 2013 / Published online: 29 August 2013

Abstract Several current debates in the epistemology of testimony are implicitly motivated by concerns about the reliability of rules for changing one's beliefs in light of others' claims. Call such rules testimonial norms (TNs). To date, epistemologists have neither (i) characterized those features of communities that influence the reliability of TNs, nor (ii) evaluated the reliability of TNs as those features vary. These are the aims of this paper. I focus on *scientific* communities, where the transmission of highly specialized information is both ubiquitous and critically important. Employing a formal model of scientific inquiry, I argue that miscommunication and the "communicative structure" of science strongly influence the reliability of TNs, where reliability is made precise in three ways.

$$\overbrace{\text{Social Learning} \; + \; \text{Conformity Bias}}^{\text{Explore}}$$

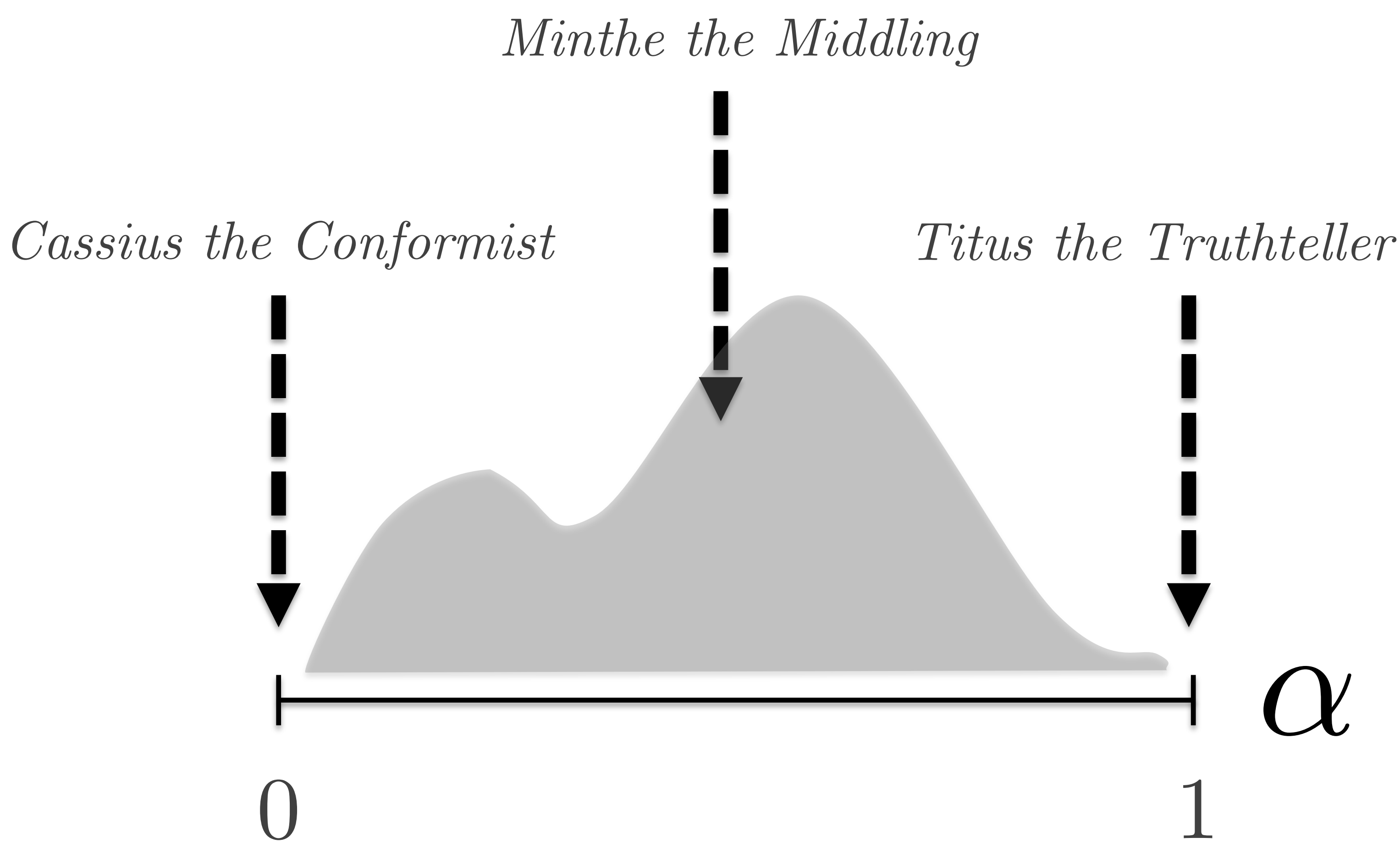
Can we say something general?

The Model

Story: *Caesar or Pompeia*

$$\theta \quad or \quad \neg\theta$$

Distribution of conformity orientations



Agent i's payoffs for a declaration

Truth-seeking orientation — **Conformity** orientation

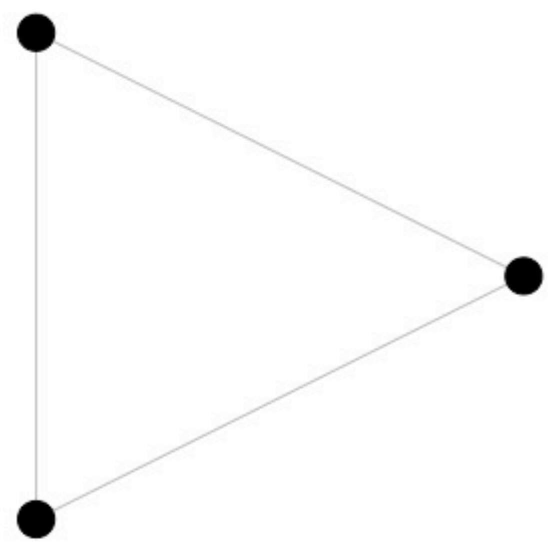
$$U_i(x) = \overbrace{\alpha_i}^{\textbf{Truth-seeking}\text{ orientation}} \underbrace{P_i(x)}_{\substack{\textbf{Belief}\text{ in the truth} \\ \text{of the declaration}}} + \overbrace{(1-\alpha_i)}^{\textbf{Conformity}\text{ orientation}} \underbrace{N_i(x)}_{\substack{\text{Proportion of }\textbf{Neighbors} \\ \text{making the same declaration}}}$$

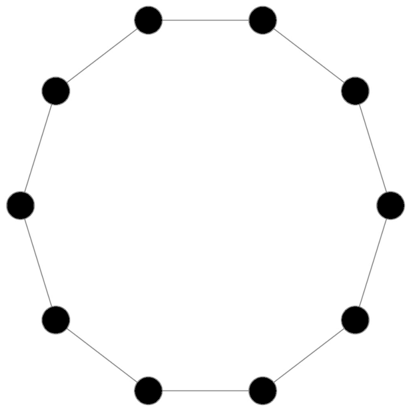
Belief in the truth of the declaration — Proportion of **Neighbors** making the same declaration

Our agents inhabit a social network

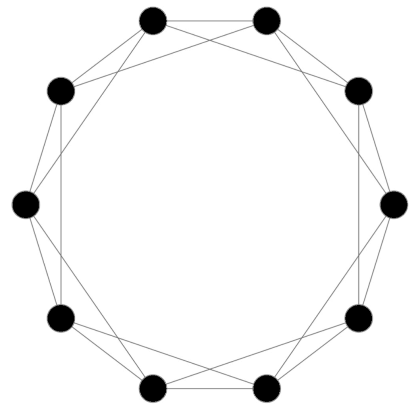
Agents are represented by *nodes*.

Social influence is represented by edges.

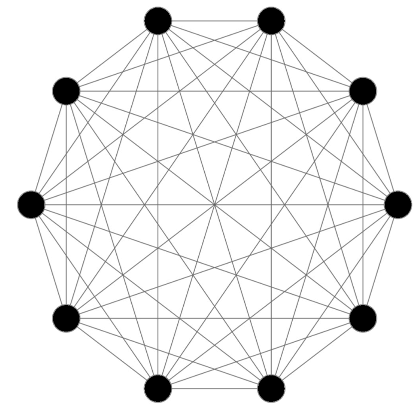




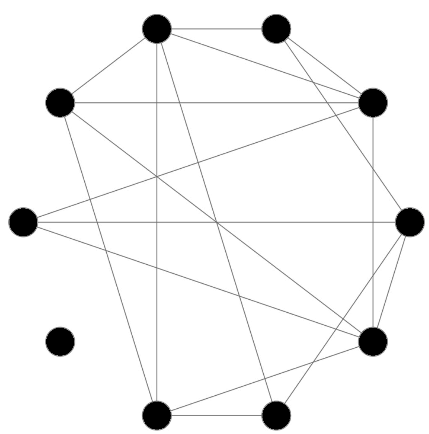
Circle



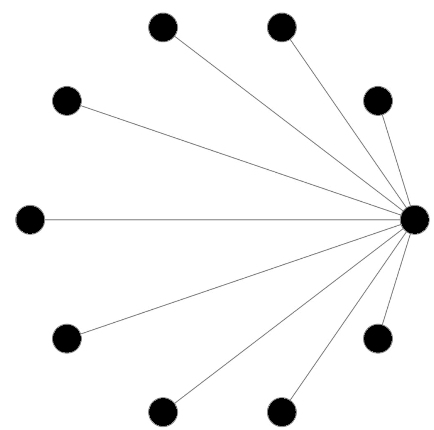
Regular d-4



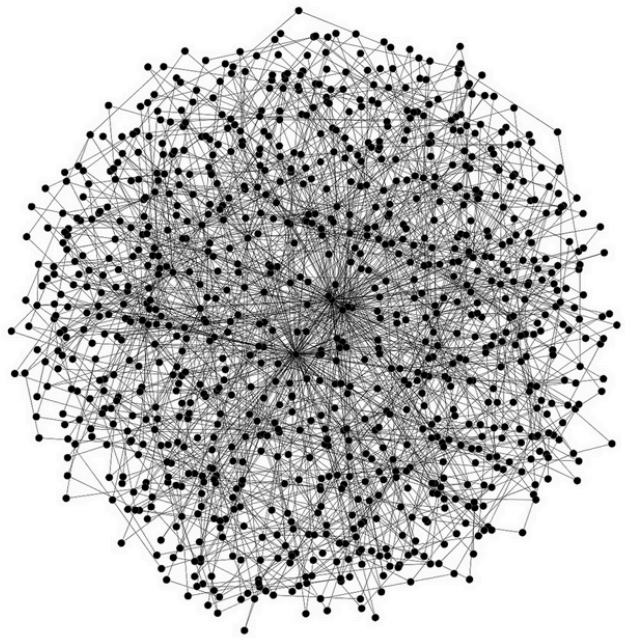
Complete



ER Random

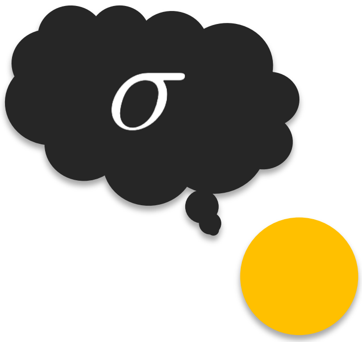


Star



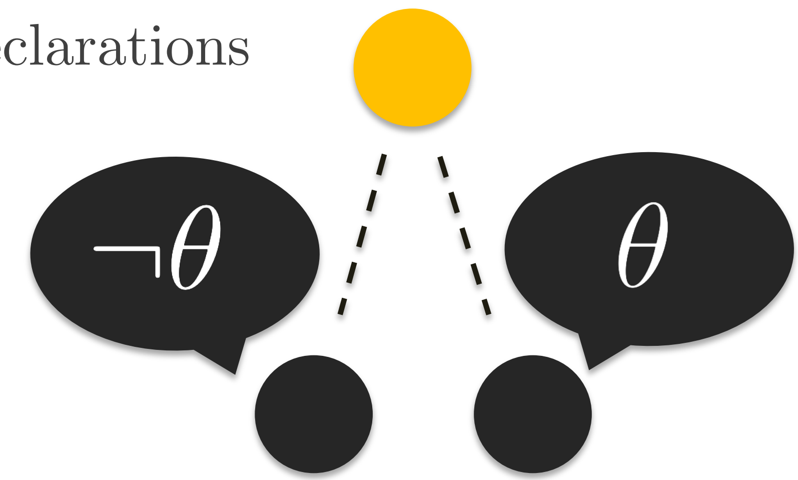
Something else?

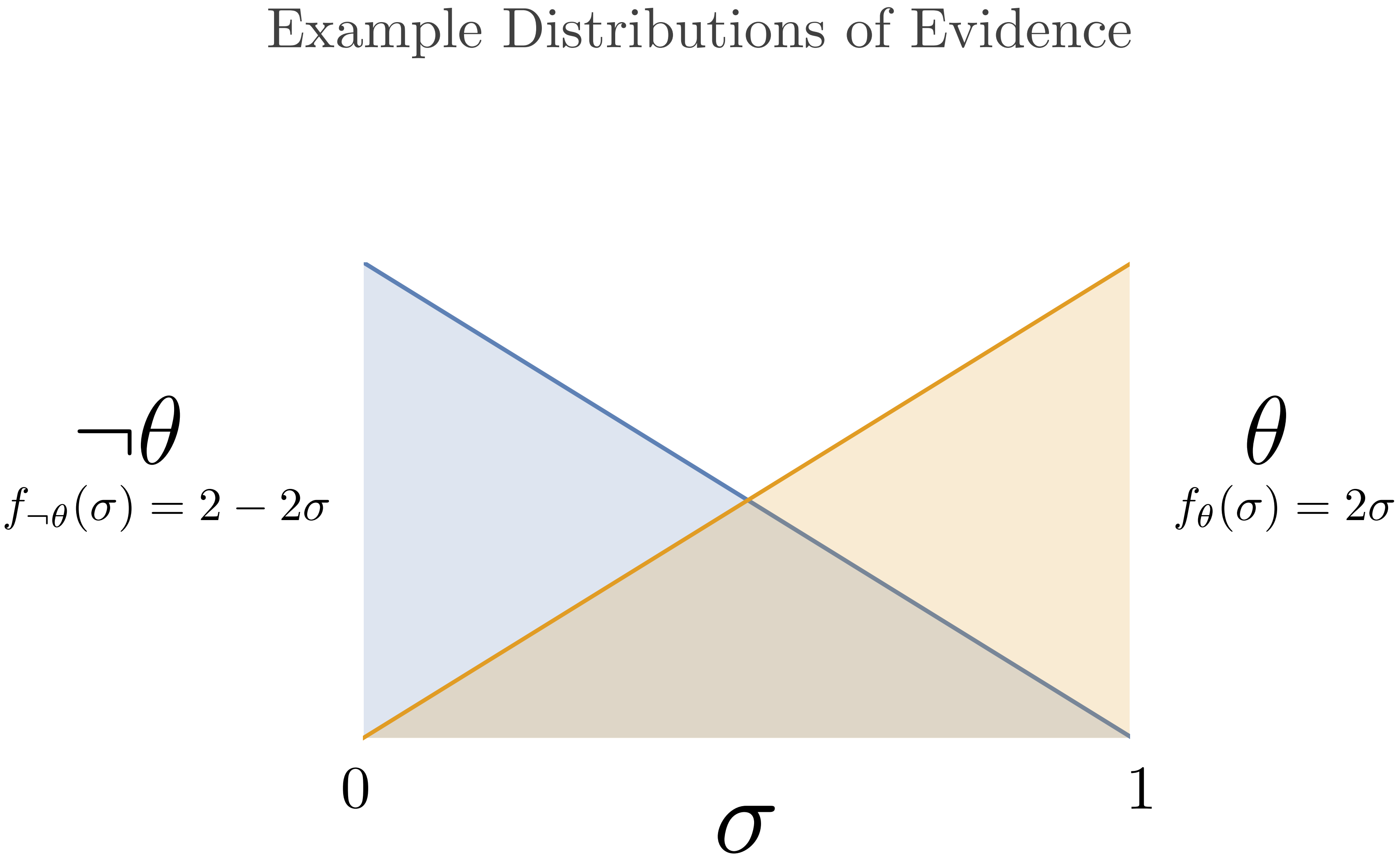
Learning



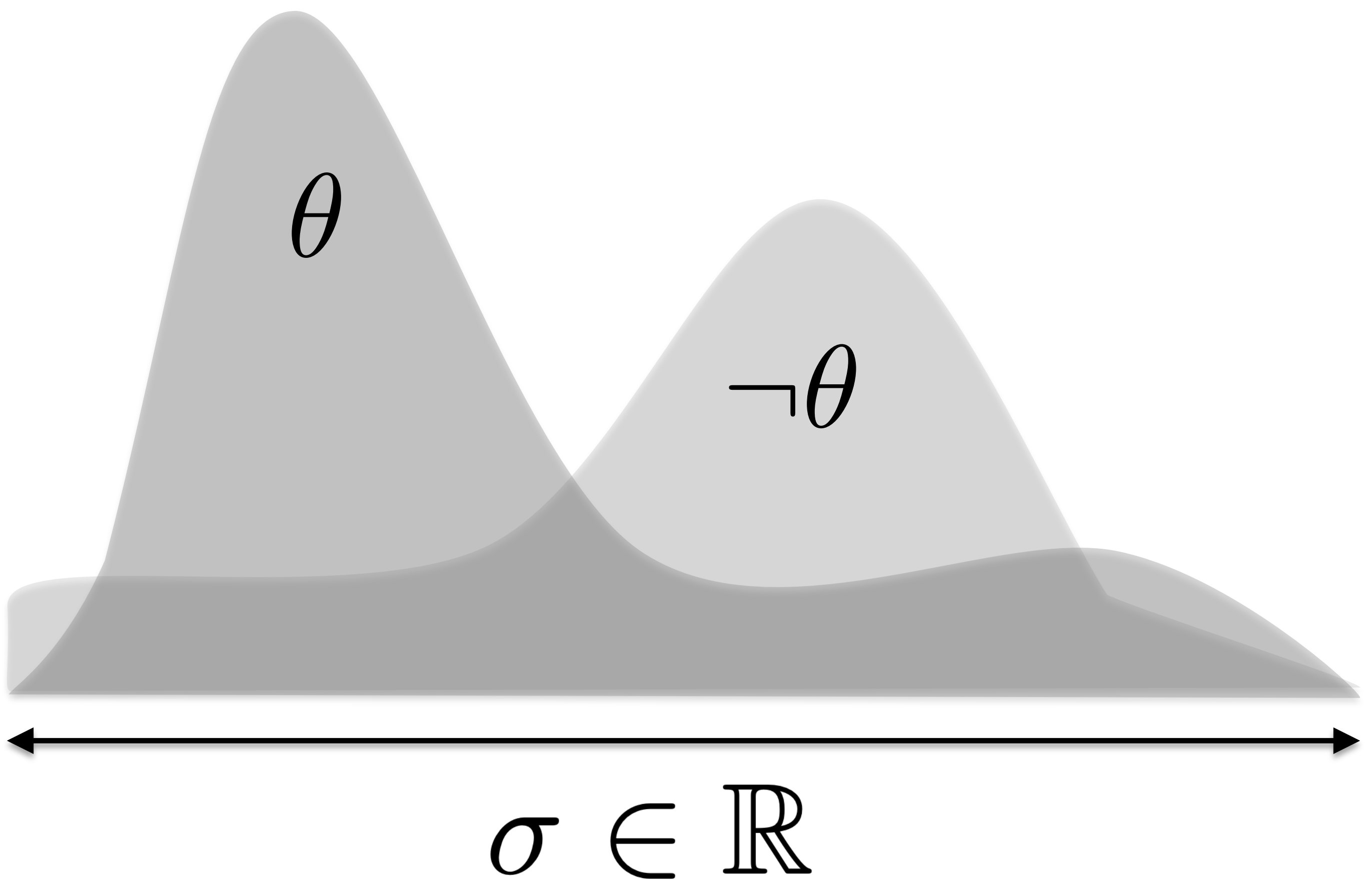
1. Private evidence

2. Public declarations

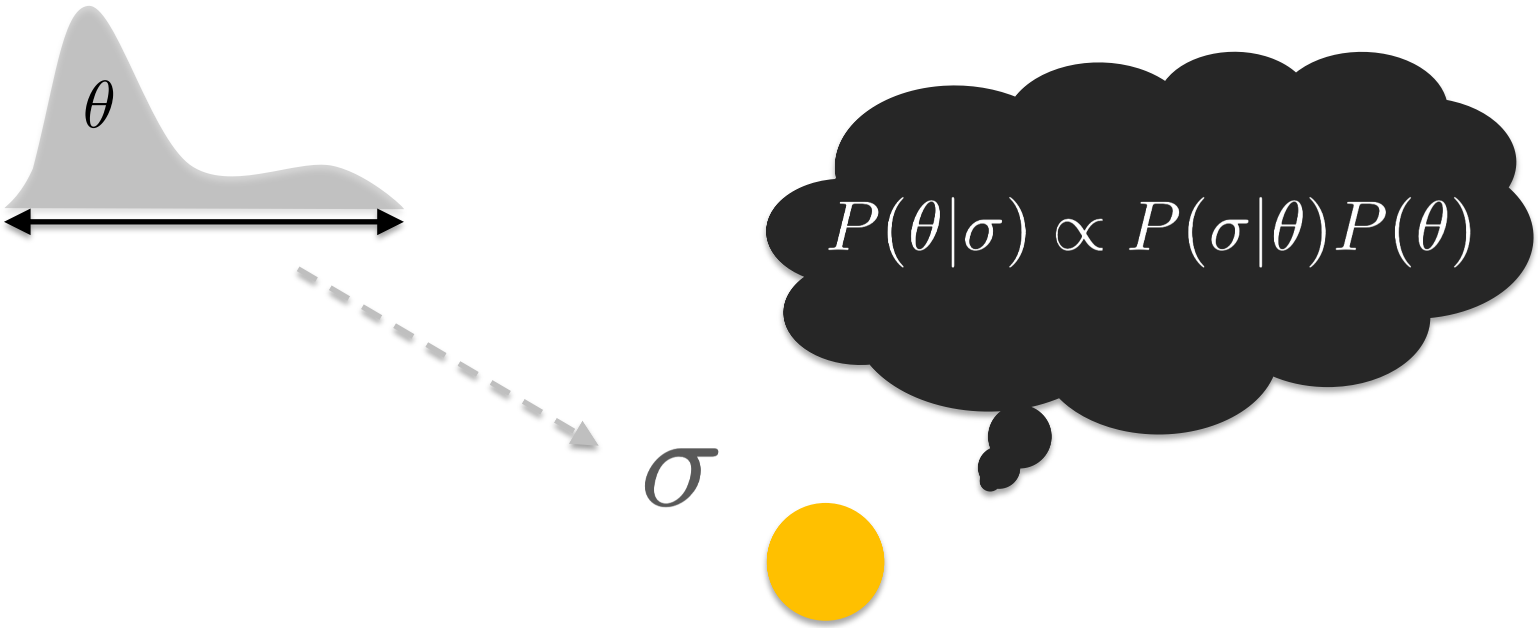



Example Distributions of Evidence
$\neg\theta$
$f_{\neg\theta}(\sigma) = 2 - 2\sigma$
θ
$f_{\theta}(\sigma) = 2\sigma$
0
1
σ

General Distributions of Evidence

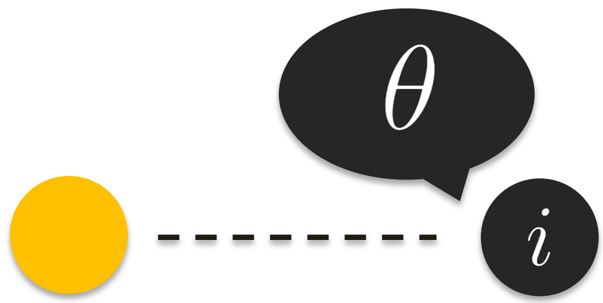


Updating on Private of Evidence



via Bayes' rule

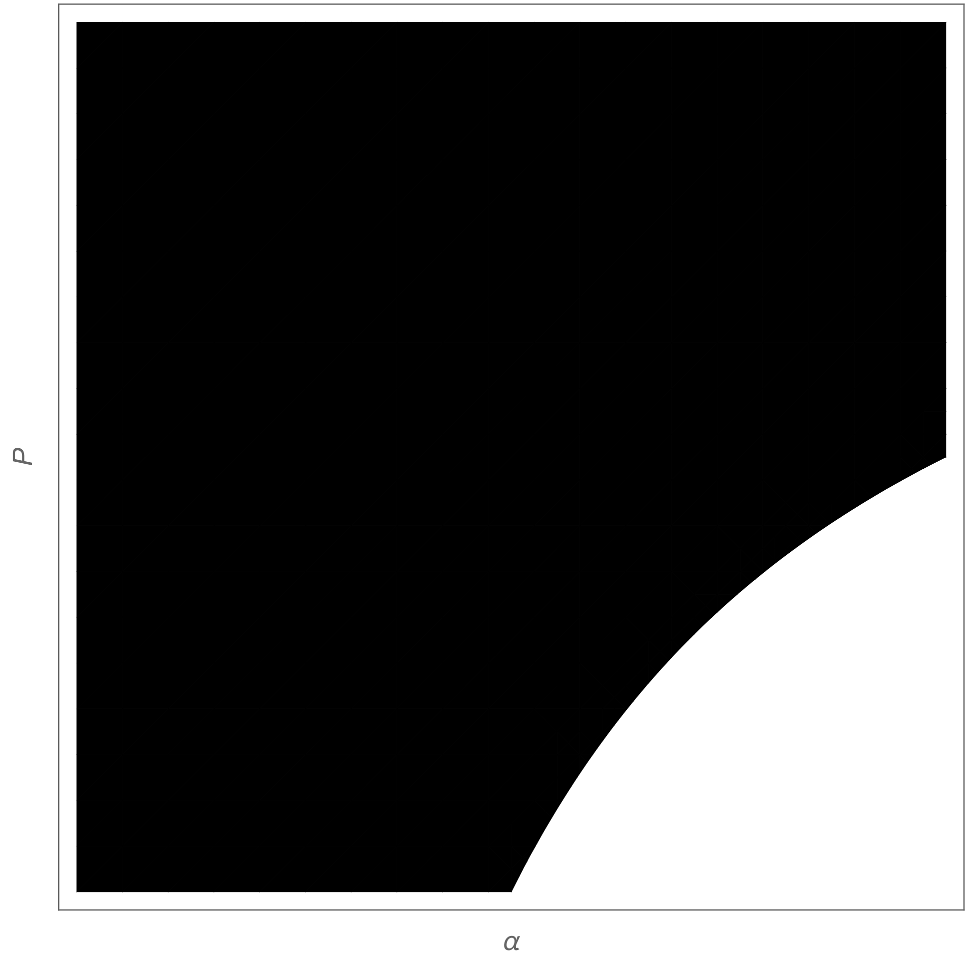
Learning from others' declarations



$$U_i(\theta) > U_i(\neg\theta)$$

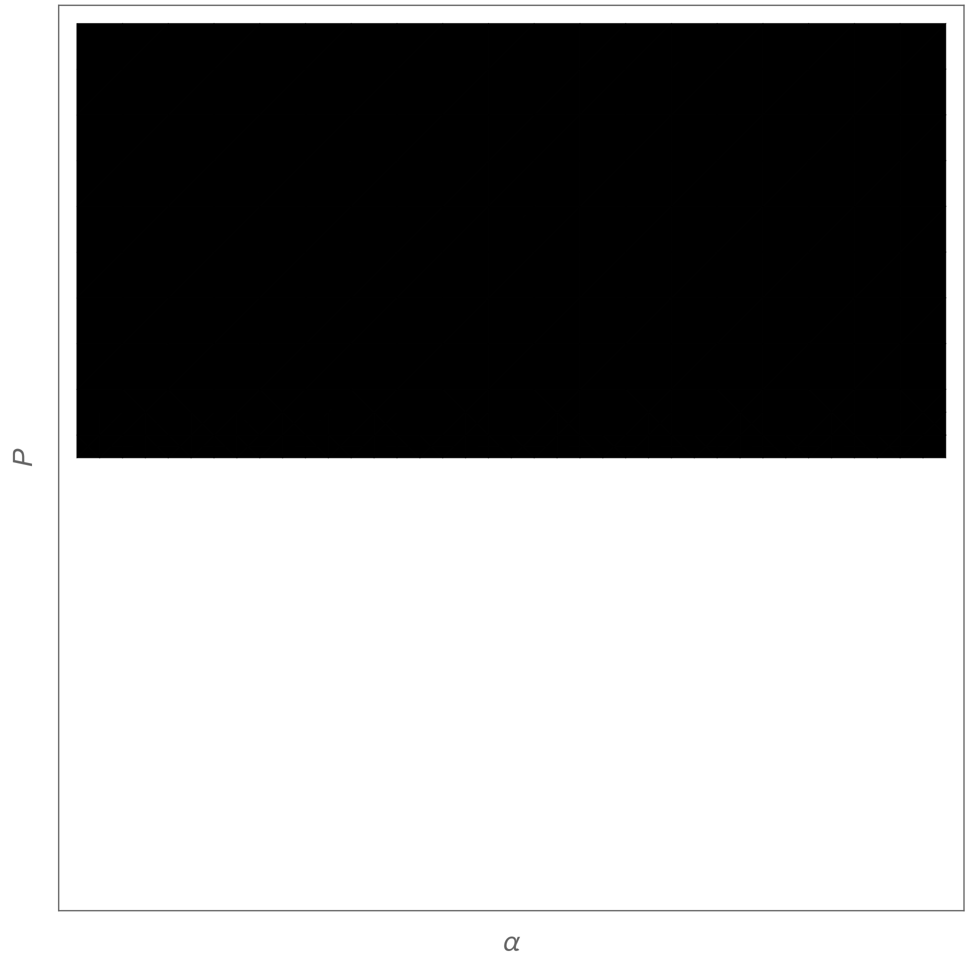
$$\alpha_i(2P_i(\theta) - 1) + (1 - \alpha_i)(2N_i(\theta) - 1) > 0$$

$$N_i(\theta) = 1$$



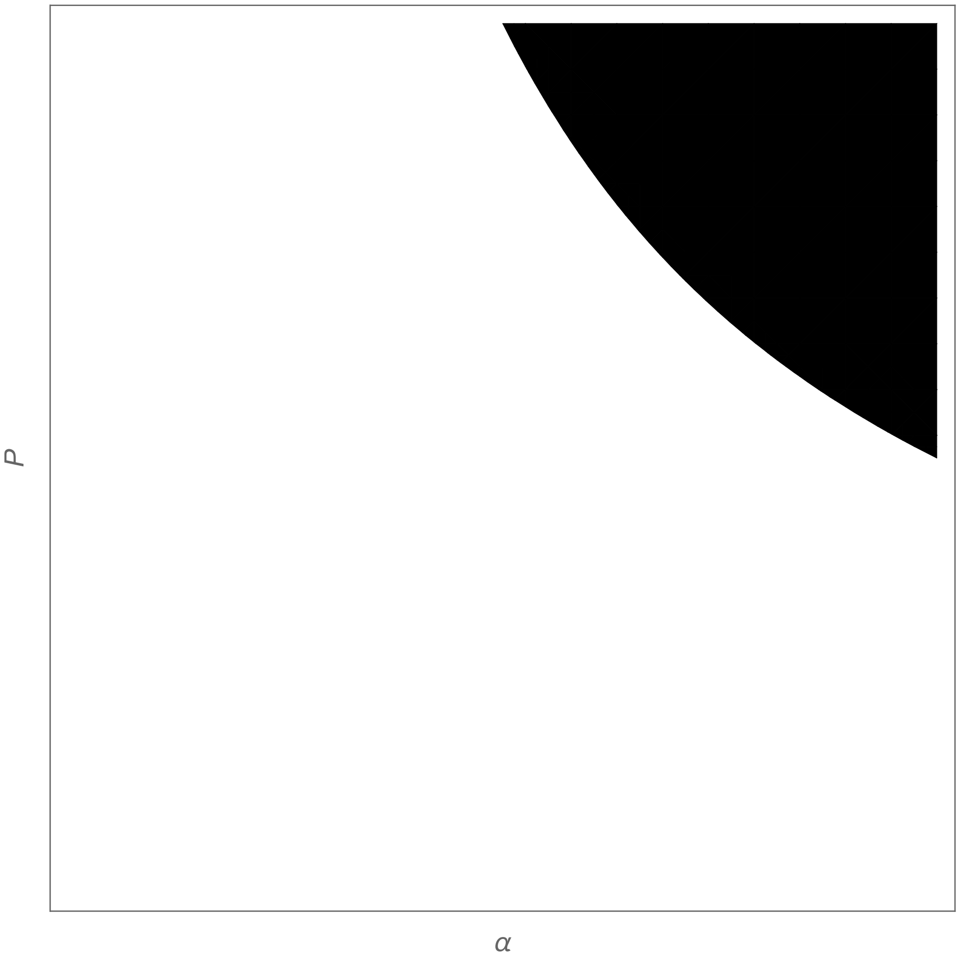
$$2\alpha_i(P_i(\theta) - 1) > -1$$

$$N_i(\theta) = \frac{1}{2}$$

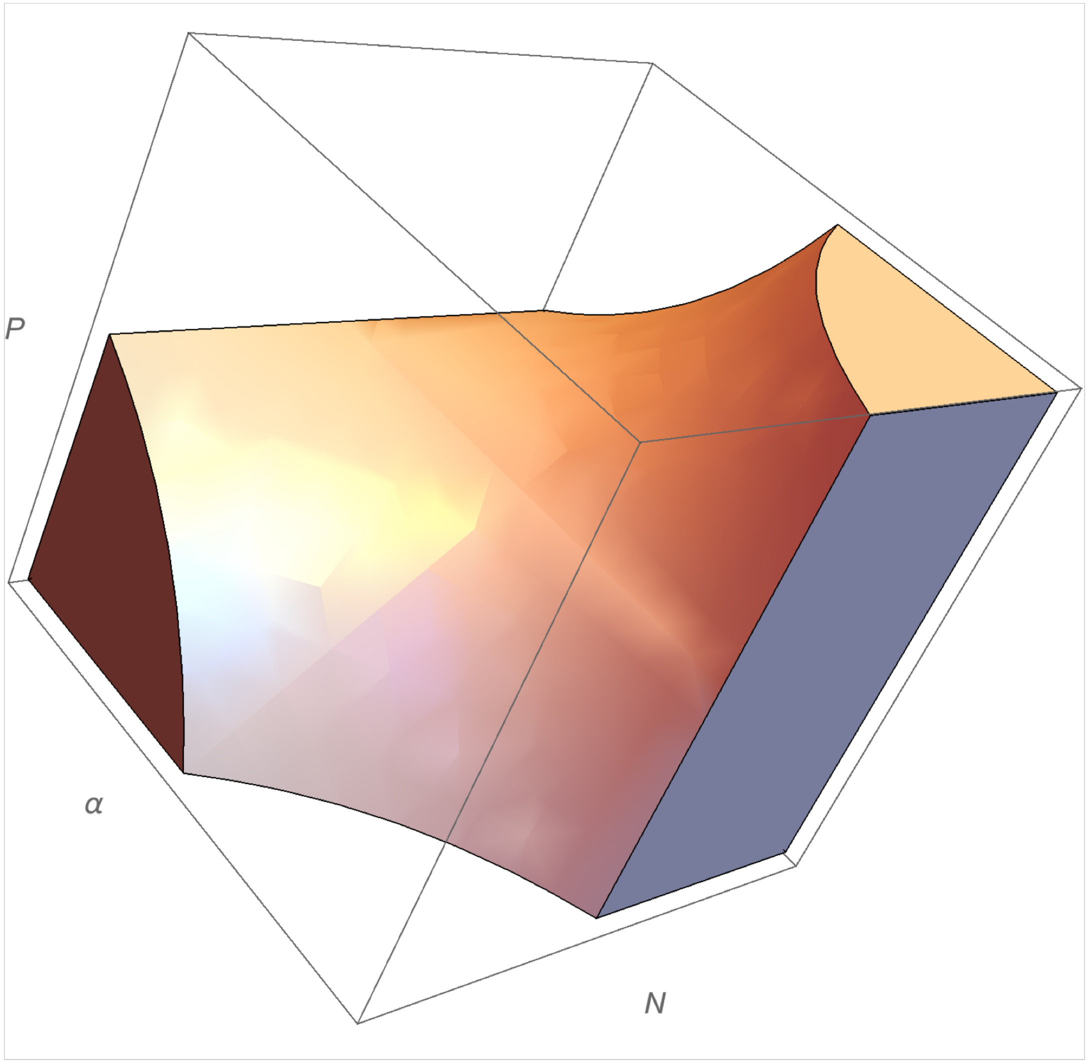


$$P_i(\theta) > \frac{1}{2}$$

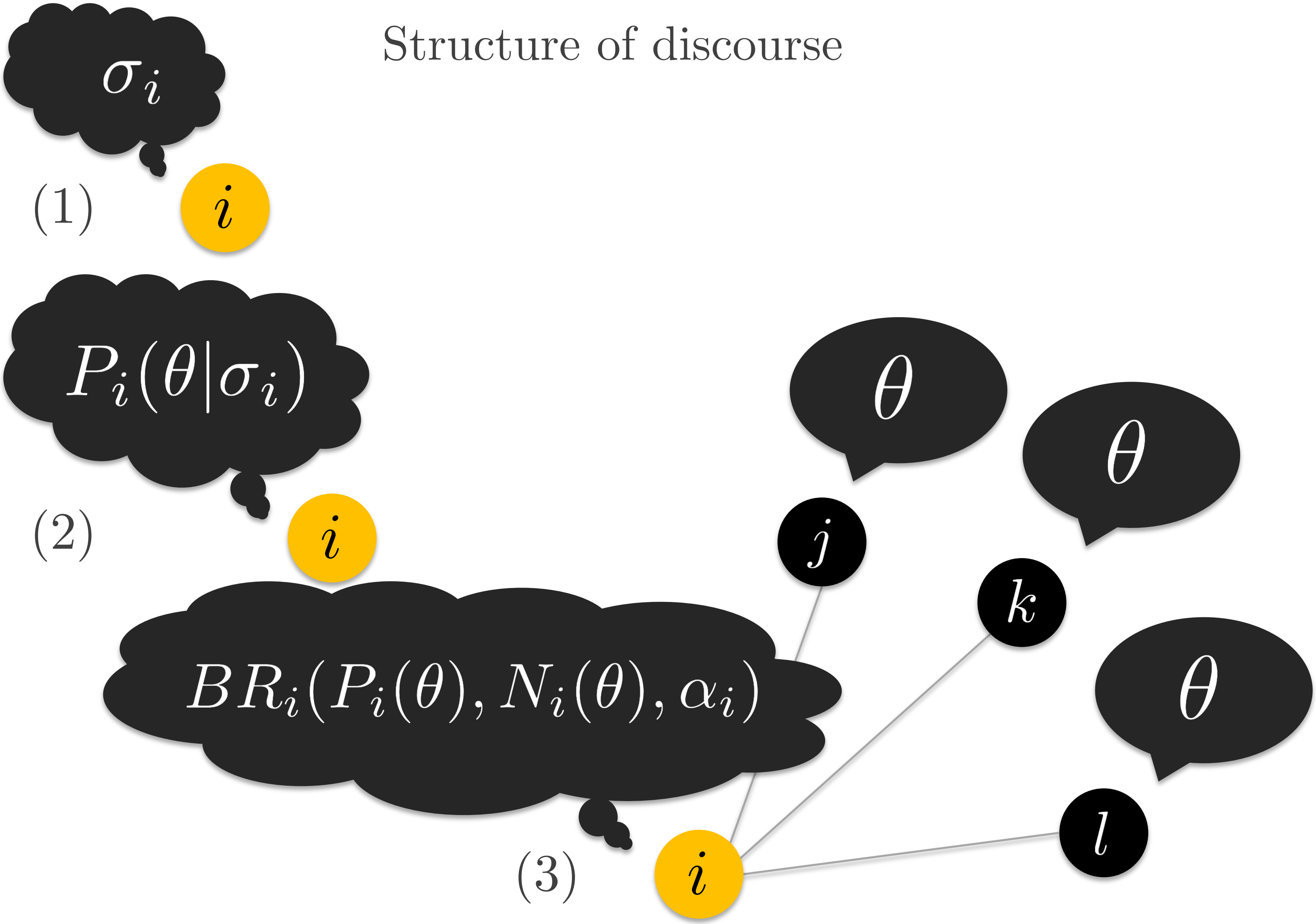
$$N_i(\theta) = 0$$



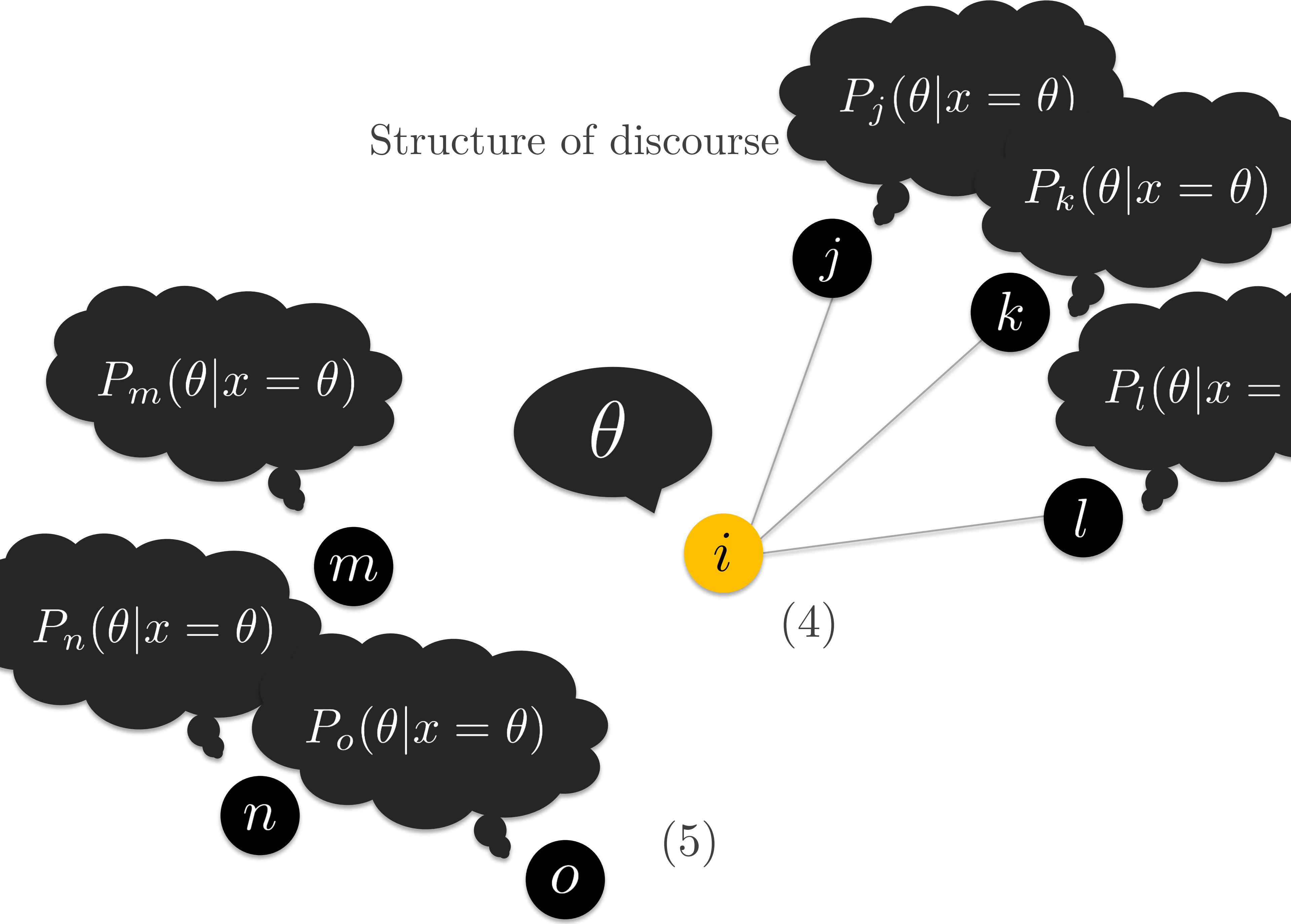
$$2\alpha_i P_i(\theta) > 1$$


P
α
N

Structure of discourse



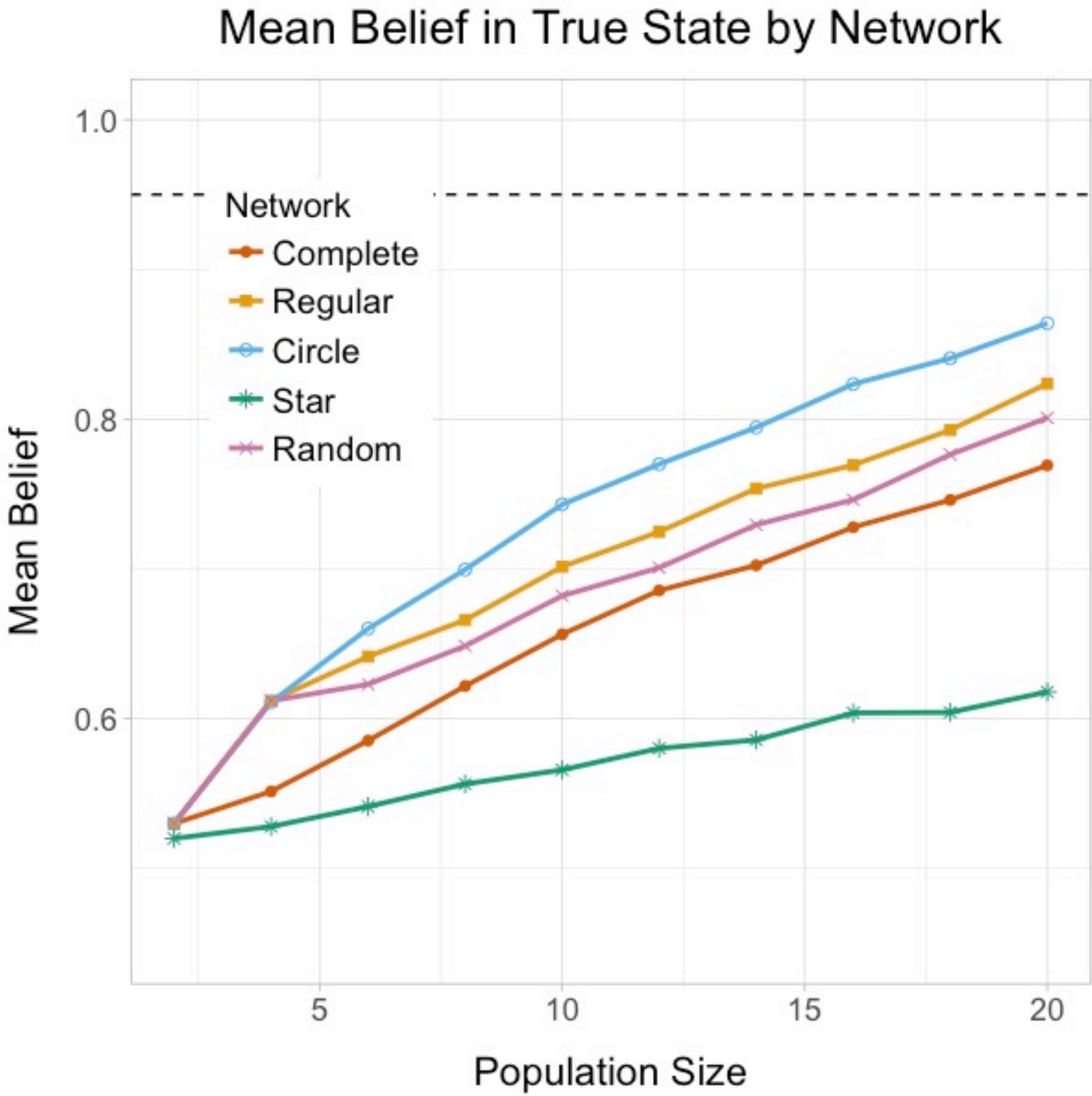
Structure of discourse



Computational Results

Parameter Sweep

- **Networks.** complete, regular, circle, star, ER random.
- **Population sizes.** 2 to 20 agents.
- **Initial declarations.** all true, all false, equally split.
- **Initial beliefs.** confidence in true state ($P(x) = 3/4$), skepticism toward true state ($P(x) = 1/4$), and ignorance about true state ($P(x) = 1/2$).

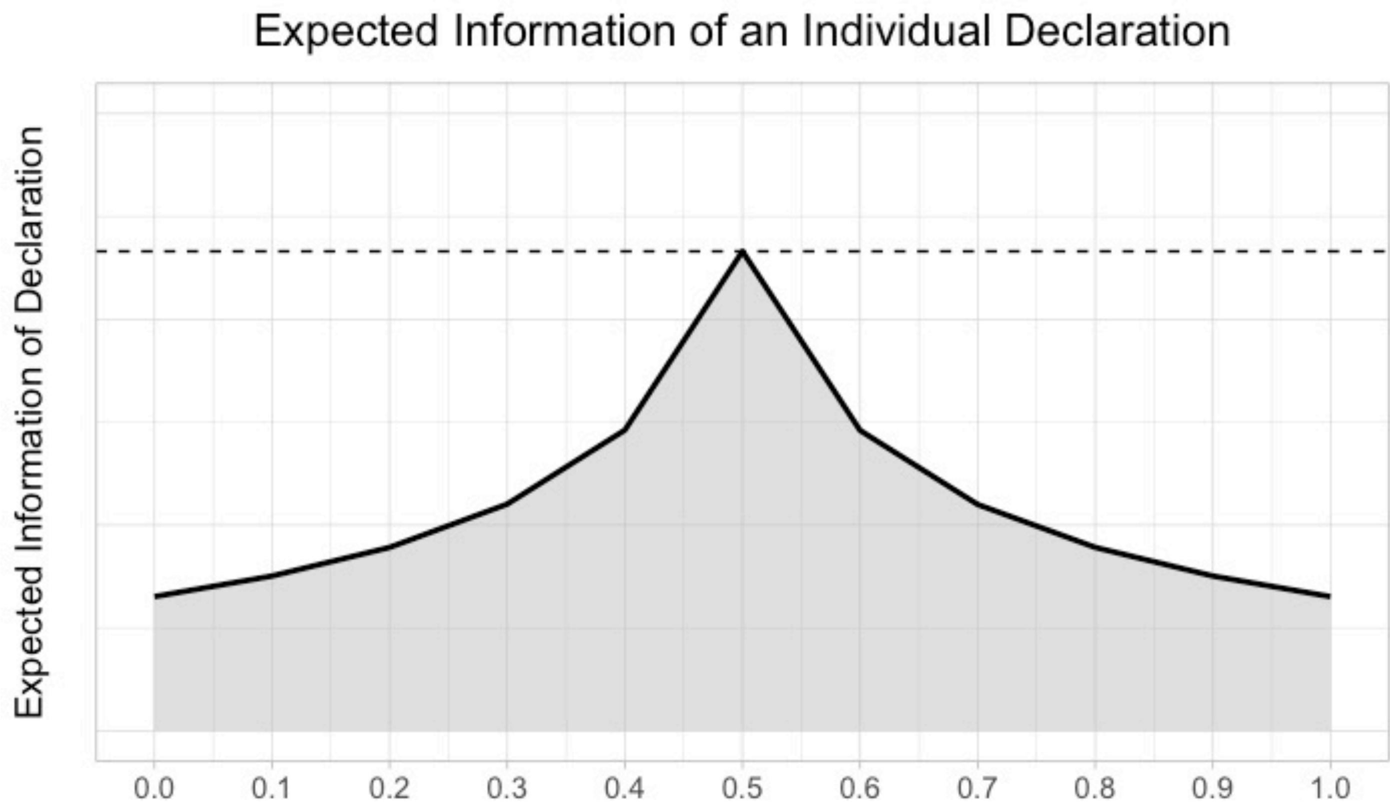


Mean Belief in True State by Network
Network
Complete
Regular
Circle
Star
Random
1.0
0.8
0.6
Mean Belief
5
10
15
20
Population Size

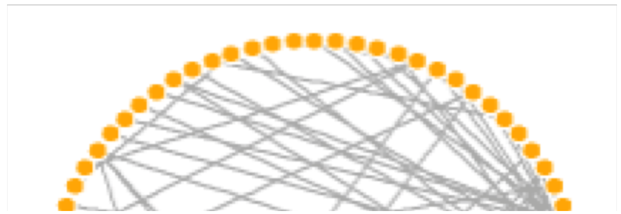
Informativeness of Declarations

$$\boldsymbol{I}(x) \equiv H(q|q(x) = 1/2) - H(q|x)$$

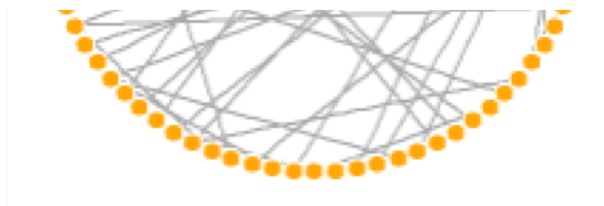
Optimal Expected Informativeness from *Conflicted Neighbors*



Proposition 1: The most influential and informative declaration, *in expectation*, is that made by an agent when her neighbors are evenly split in their declarations.



Informativeness of Networks

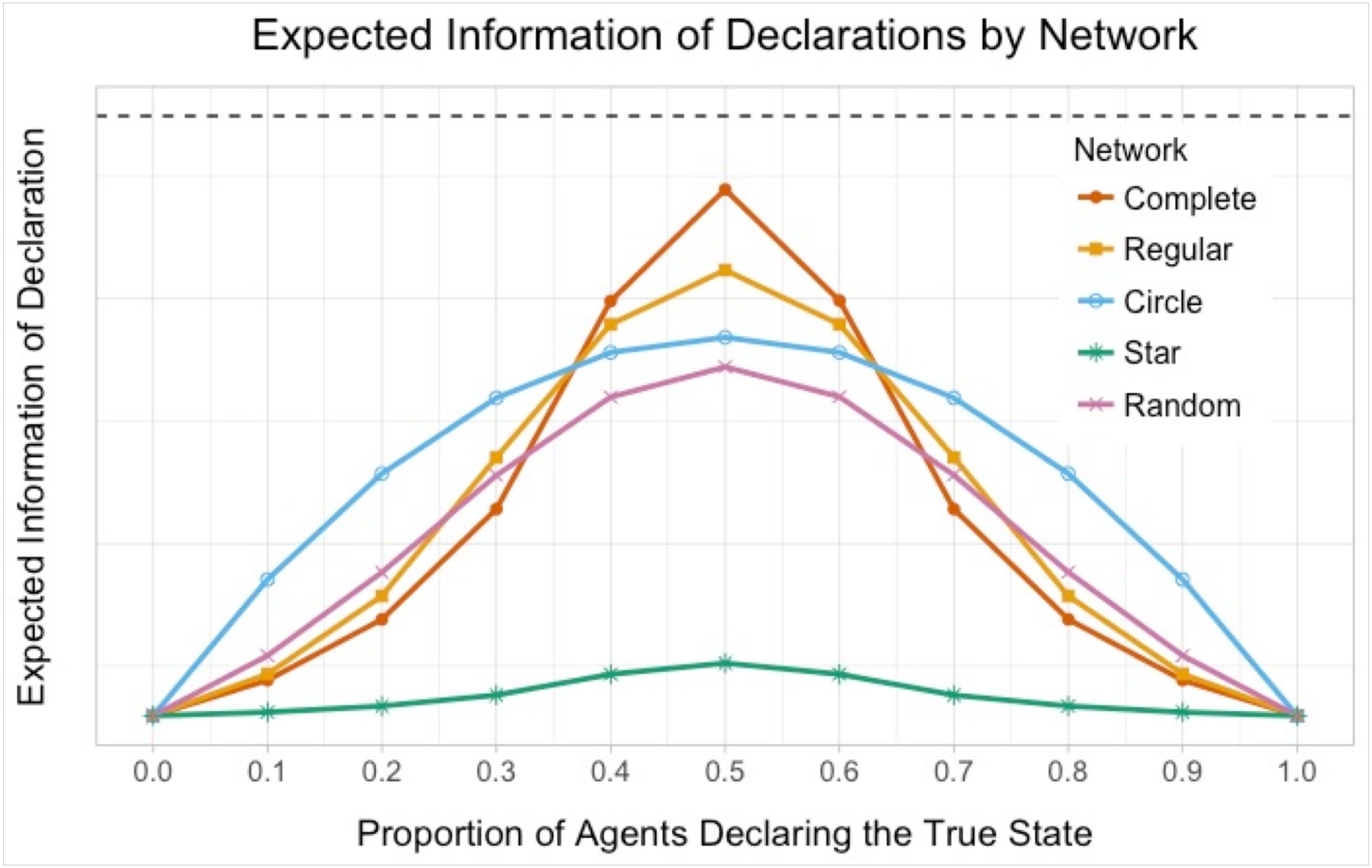


Possible configurations
of declarations

$$E_X[\boldsymbol{I}(\mathcal{G})] \propto \underbrace{\sum_{k=0}^{N}}_{\text{Number of agents declaring the true state}} \overbrace{\sum_{j=1}^{\binom{N}{k}}}^{\text{Possible configurations of declarations}} \underbrace{\sum_{i=1}^{N}}_{\text{Individual agents in the network}} E_X[\boldsymbol{I}(x_i)]$$

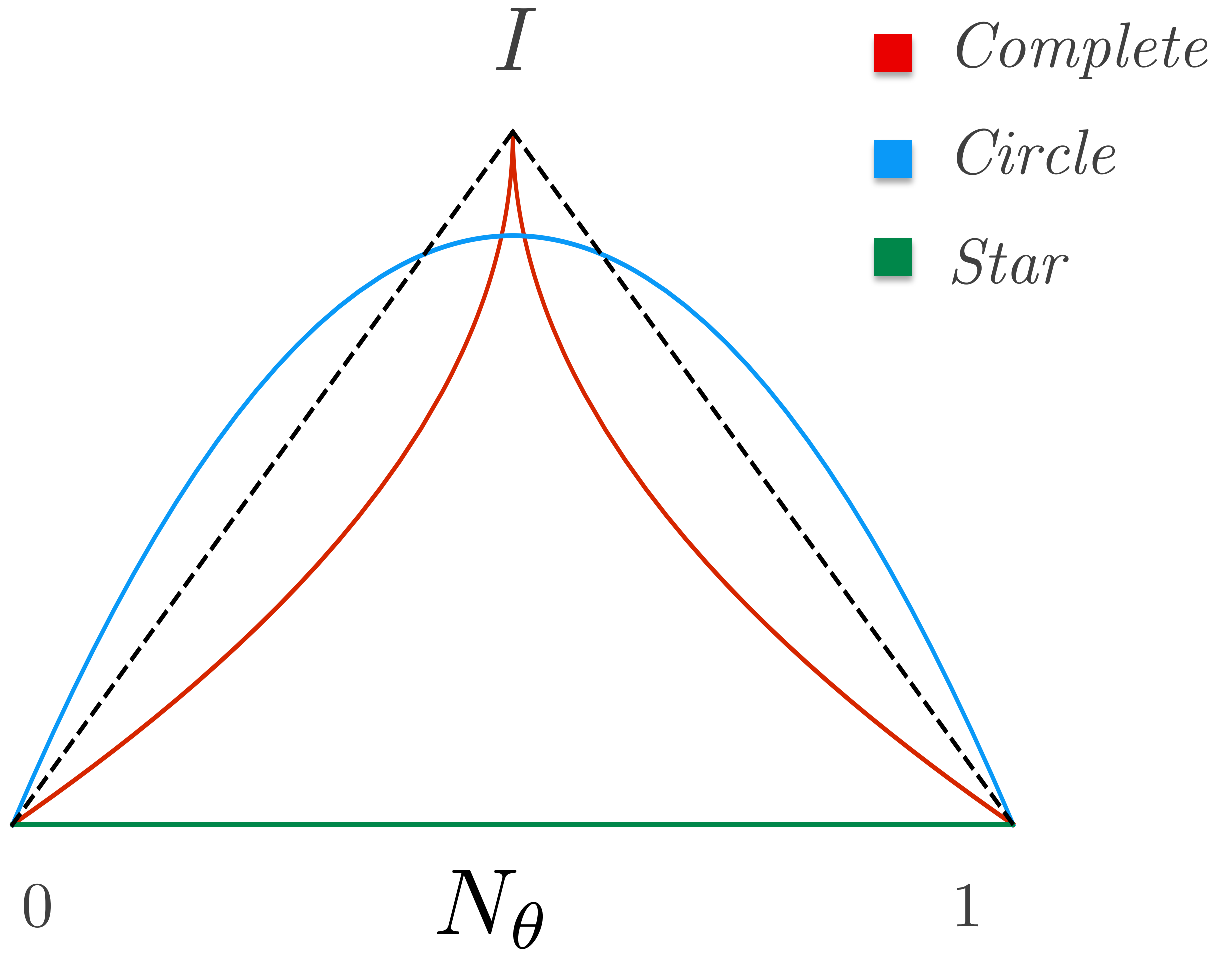
Number of agents
declaring the true state

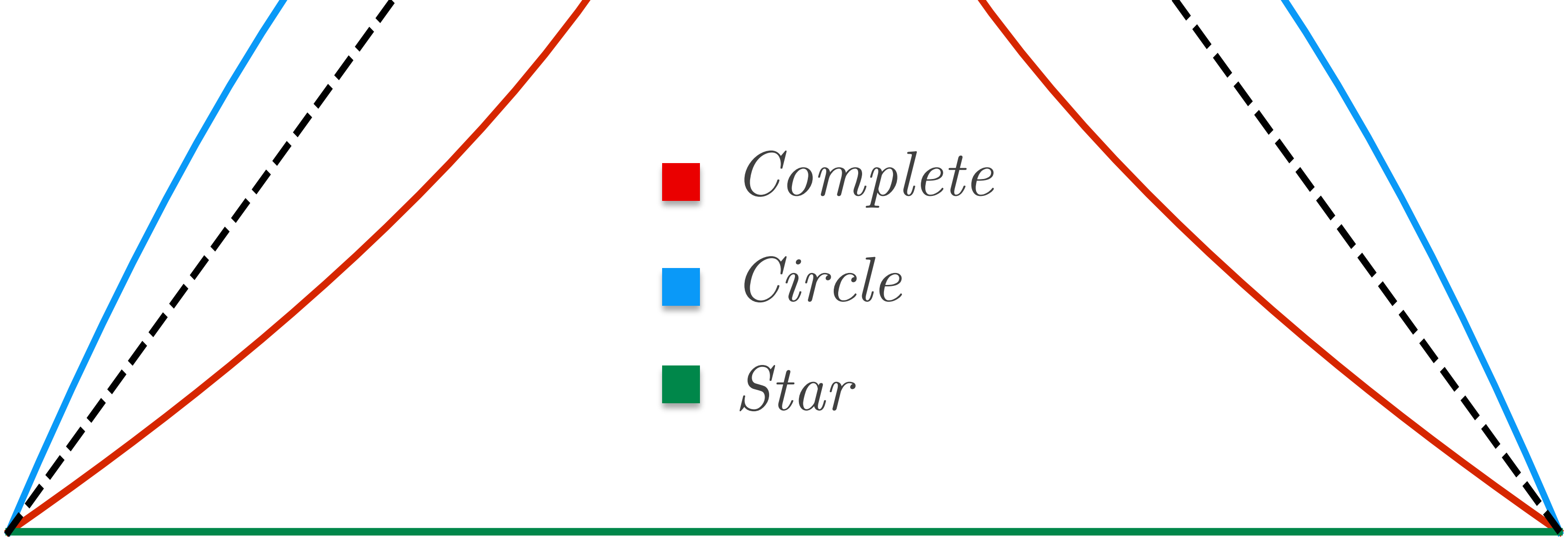
Individual agents
in the network


Expected Information of Declarations by Network
Expected Information of Declaration
Proportion of Agents Declaring the True State
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Network
Complete
Regular
Circle
Star
Random

Informativeness of Large Networks

$$N \to \infty$$

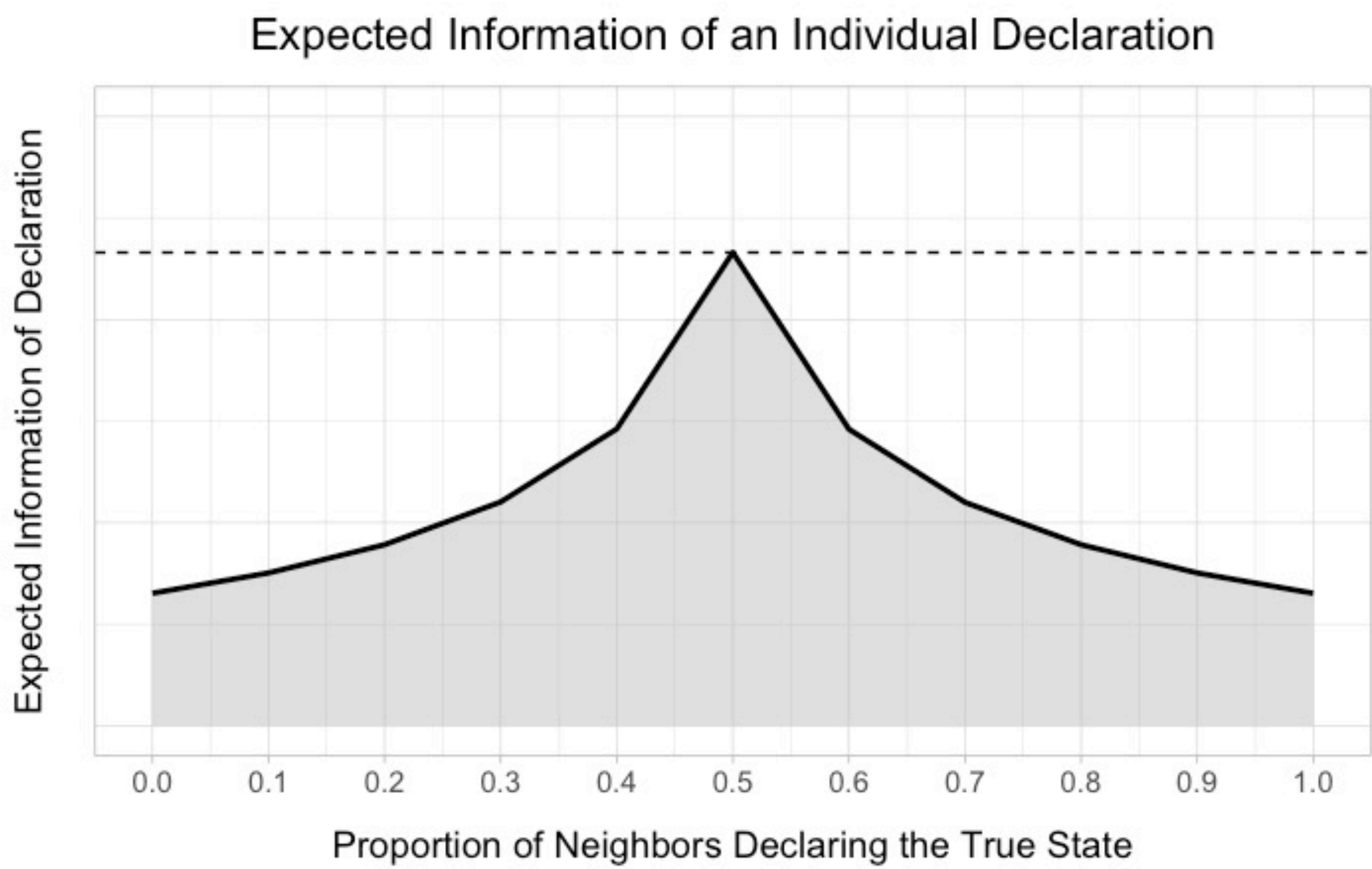

I
Complete
Circle
Star
0
N_θ
1



For all $N_\theta \in [0, 1]$

$$\forall \mathcal{G}, \boldsymbol{I}(\mathcal{G}) \geq \boldsymbol{I}(Star)$$

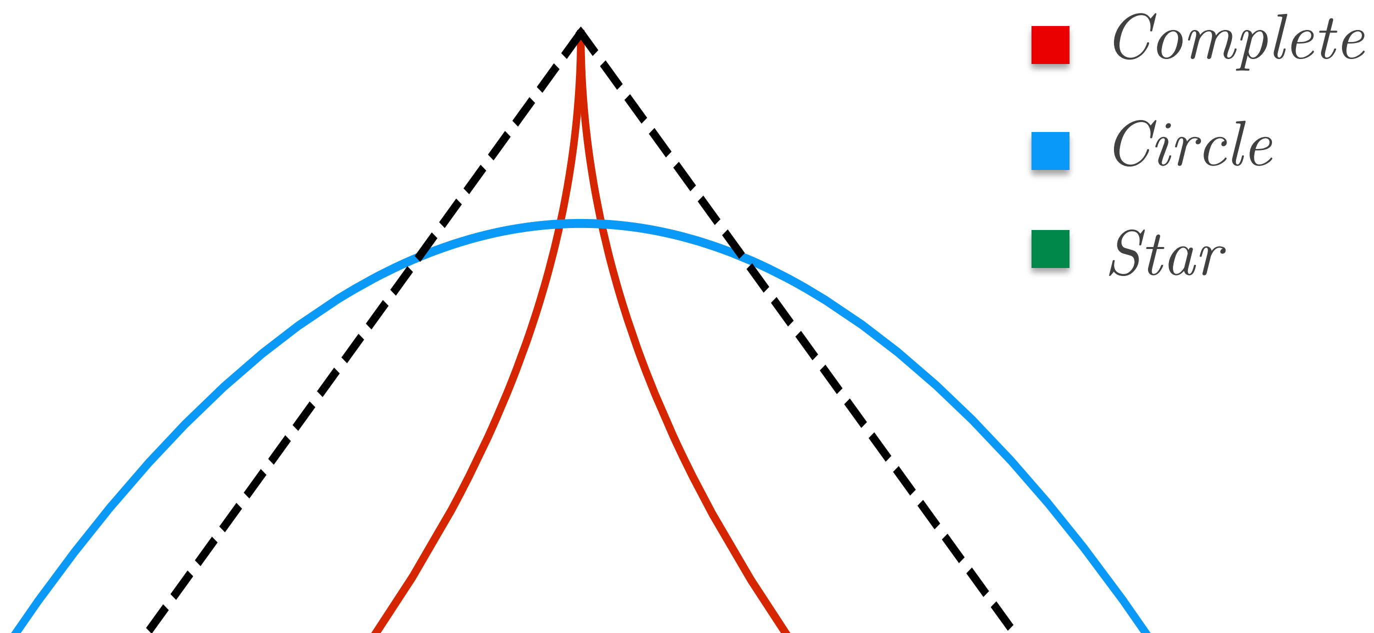
Proposition 2. For large networks, the *star network* is *minimally informative.*

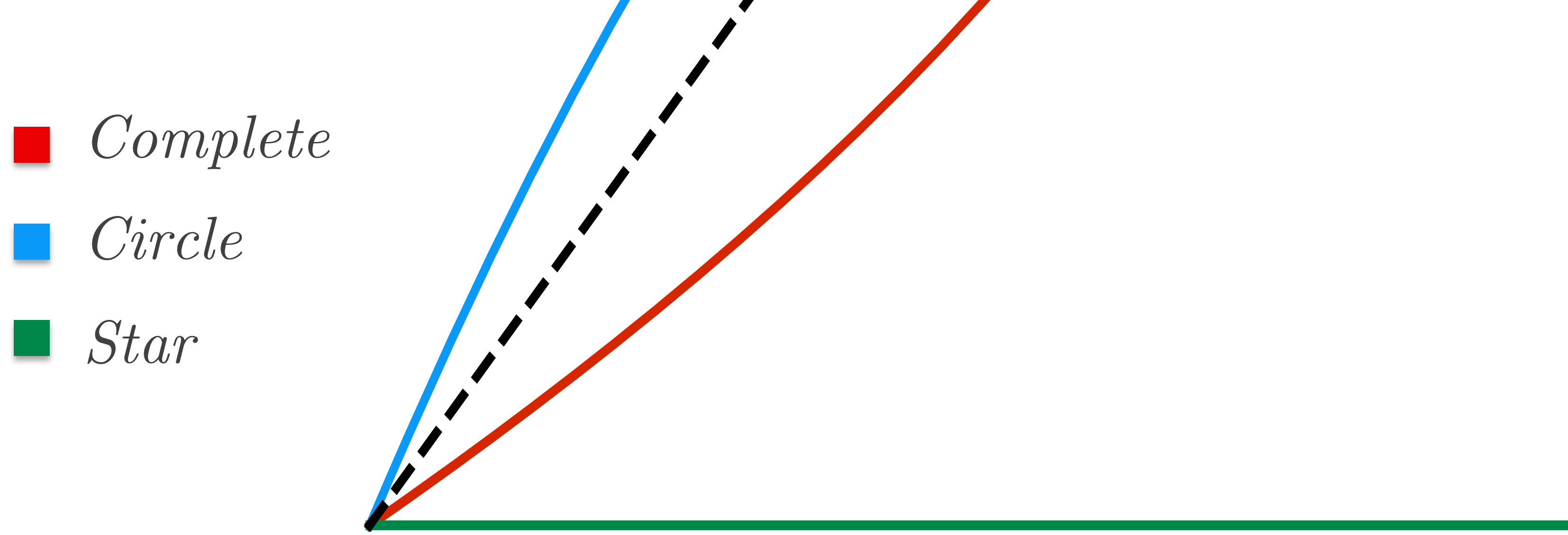

Expected Information of an Individual Declaration
Expected Information of Declaration
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Proportion of Neighbors Declaring the True State

$$\text{At } N_\theta = 1/2$$

$$\forall \mathcal{G}, \boldsymbol{I}(\mathcal{G}) \leq \boldsymbol{I}(Complete)$$

Proposition 3. For large networks, when the population is *evenly split*, the *complete network* is *maximally informative.*

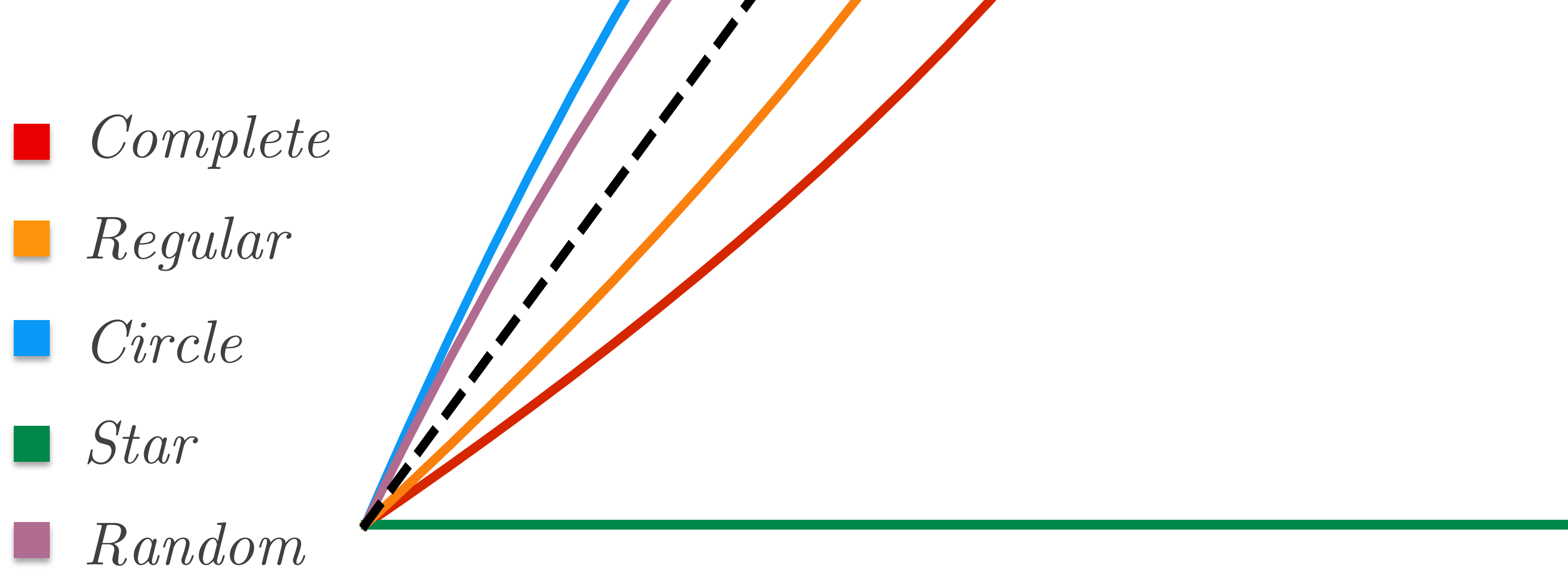




For N_θ near 0 or 1

$$\forall \mathcal{G}, \boldsymbol{I}(\mathcal{G}) \leq \boldsymbol{I}(Circle)$$

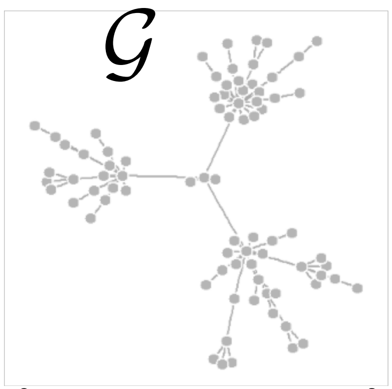
Proposition 4. For large networks, for some range of *states near consensus*, the *circle network* is *maximally informative.*



$$\boldsymbol{I}(Complete) \leq \boldsymbol{I}(\mathcal{G}) \leq \boldsymbol{I}(Circle)$$

Proposition 5. For large networks, near consensus, *all networks* (including regular and random networks) of minimal degree at least two will be *intermediate in informativeness* to the circle and complete network.

Assumptions



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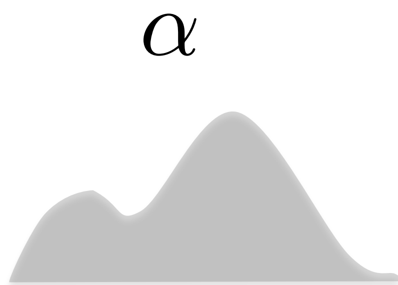

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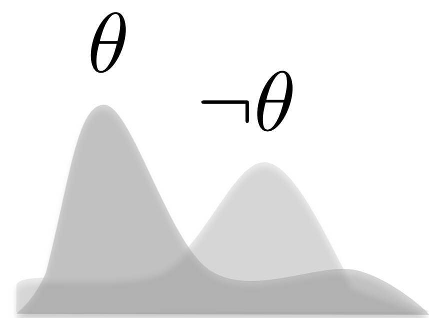


Some network of influences

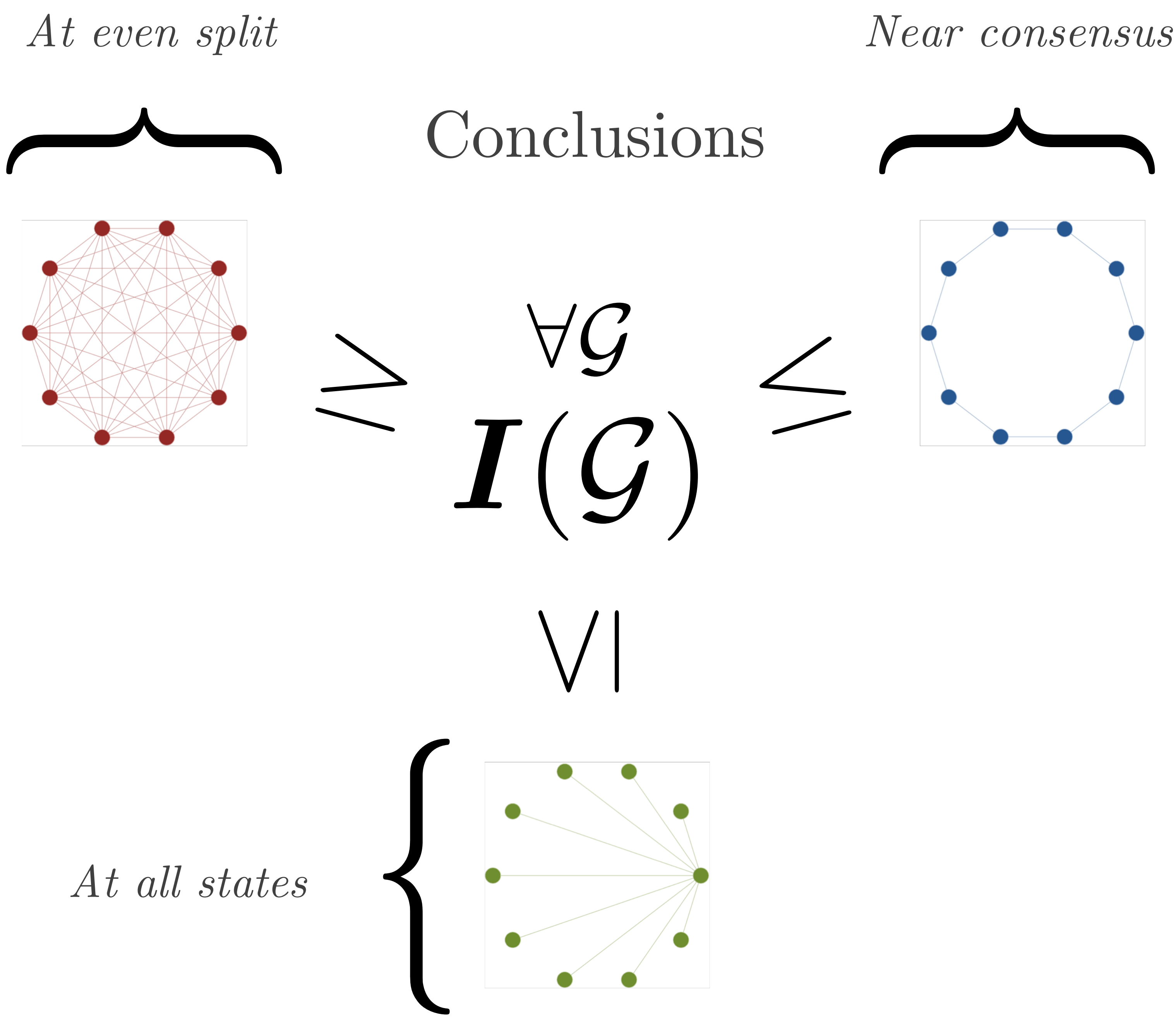
- *Connected*
- *Bidirectional edges*

Some distribution of conformity biases

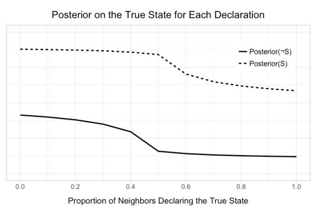
- *Full support*

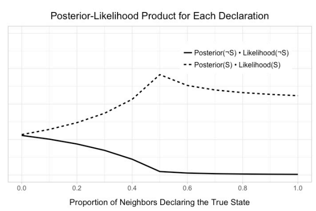
Some states of the world

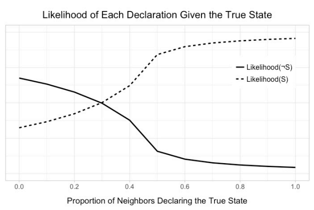
- *Distinct*
- *Mutual absolute continuity*

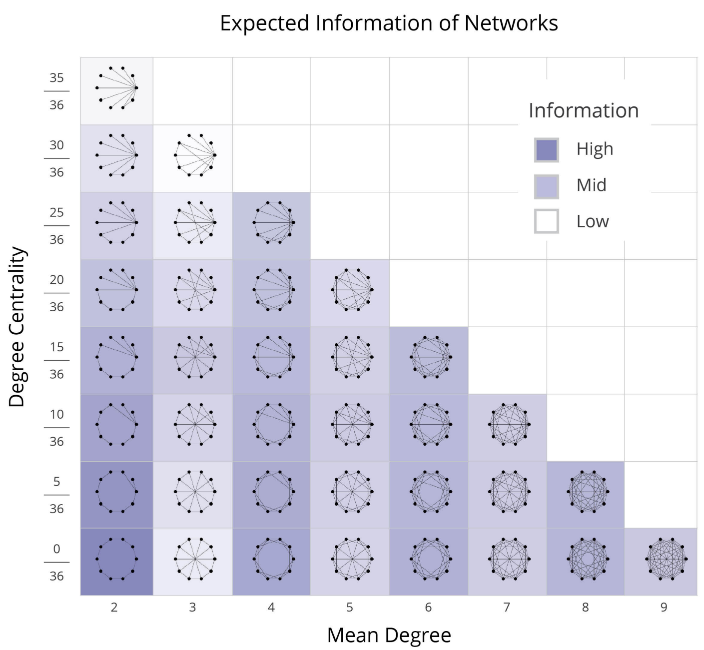

At even split
Conclusions
Near consensus
$\geq$
$\forall \mathcal{G}$
$\boldsymbol{I}(\mathcal{G})$
$\leq$
$\geq$
At all states

There's more that can be said...









Moral I: honest communication is bolstered by *diversity of opinions*

Moral II: social networks *differentially* produce and sustain this diversity

Thank you.

R Shiny GUI for the model

amohseni.shinyapps.io/Truth-and-Conformity-on-Networks

Open source code on GitHub

github.com/amohseni/Truth-and-Conformity-on-Networks