

Modeling Worship Attendance

An exploration of endogenous effects

John A. Bernau, PhD

Emory University

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I. How Should We Do Social Science?

1. Human behavior is interactive
 2. This gives rise to complex, often unexpected, group-level phenomena
 3. Group-level phenomena also affects subsequent behavior
-
- Social life is interactive, generative, and recursive.

I. How Should We Do Social Science?

- Micro vs. Macro
 - Structure vs. Agency
 - Static states vs. Dynamic processes
 - Describe vs. Explain
 - Laws vs. Mechanisms
-
- Many methods: interviews, focus groups, surveys, history, etc.

I. How Should We Do Social Science?

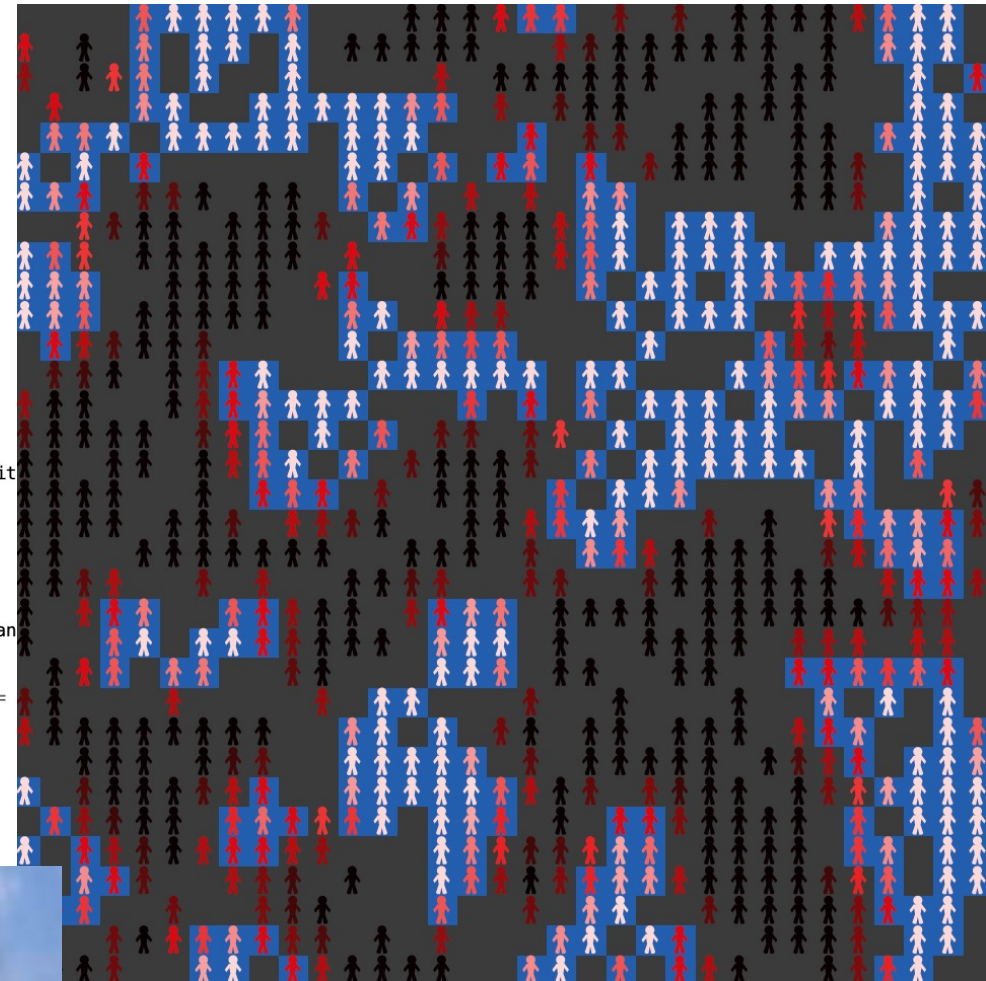
- Agent-Based Modeling addresses these features
- NetLogo software language

```
;; RELIGIOSITY toggle between global and individual religiosity
if ( religiosity-world = "global" ) [ set religiosity global-religiosity ]
if ( religiosity-world = "individual" ) [ set religiosity random-normal individual-religiosit
if ( religiosity < 0 ) [ set religiosity 0 ] ;; bound religiosity 0 to 1
if ( religiosity > 1 ) [ set religiosity 1 ]
;;set color scale-color red religiosity 0 1 ;; set color to religiosity (white = pope)

;; SOCIAL INFLUENCE toggle between global and individual social influence
if ( influence-world = "global" ) [ set social-influence global-si ]
if ( influence-world = "individual" ) [ set social-influence random-normal individual-si-mean
if ( social-influence < 0 ) [ set social-influence 0 ] ;; bound religiosity 0 to 1
if ( social-influence > 1 ) [ set social-influence 1 ]
;;set color scale-color green social-influence 0 1 ;; set color to social-influence (white =

set org-member? false
set rel-demand 0
set stay? false

;; PLOT AXES toggle plot - meaningful axes or random? SKIP FOR NOW
if ( plot-axes = "rel-x-si" ) [
```



I. How Should We Do Social Science?

- James Coleman (Coleman's boat)

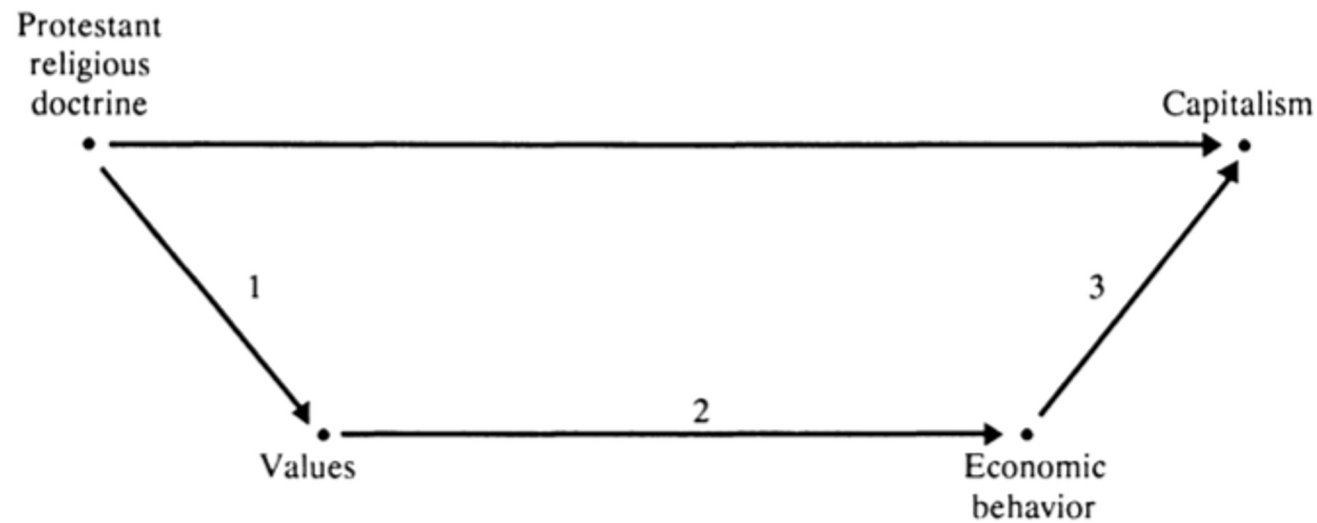
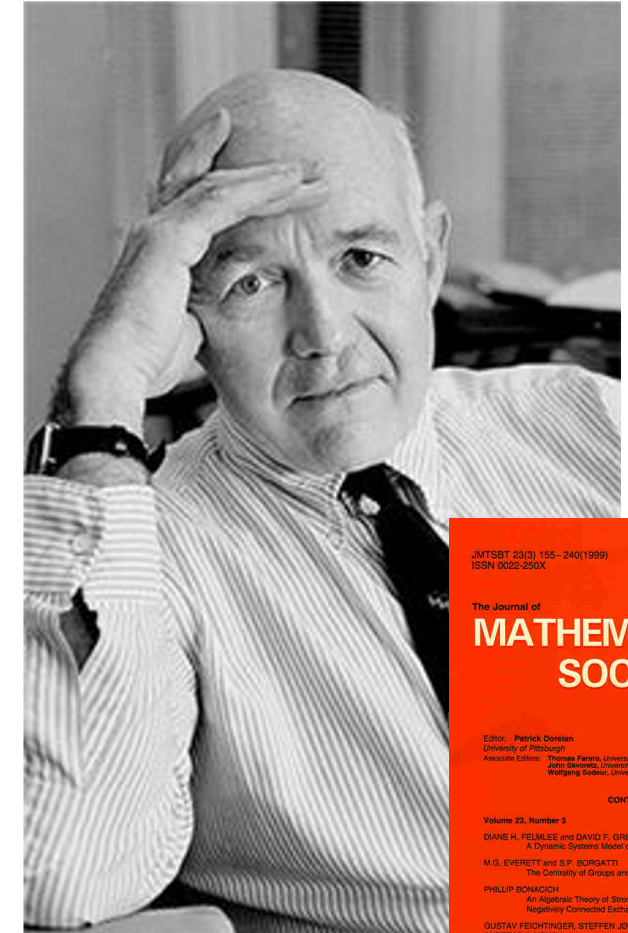


Figure 1.2 Macro- and micro-level propositions: effects of religious doctrine on economic organization.



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I. How Should We Do Social Science?

- Analytical Sociology

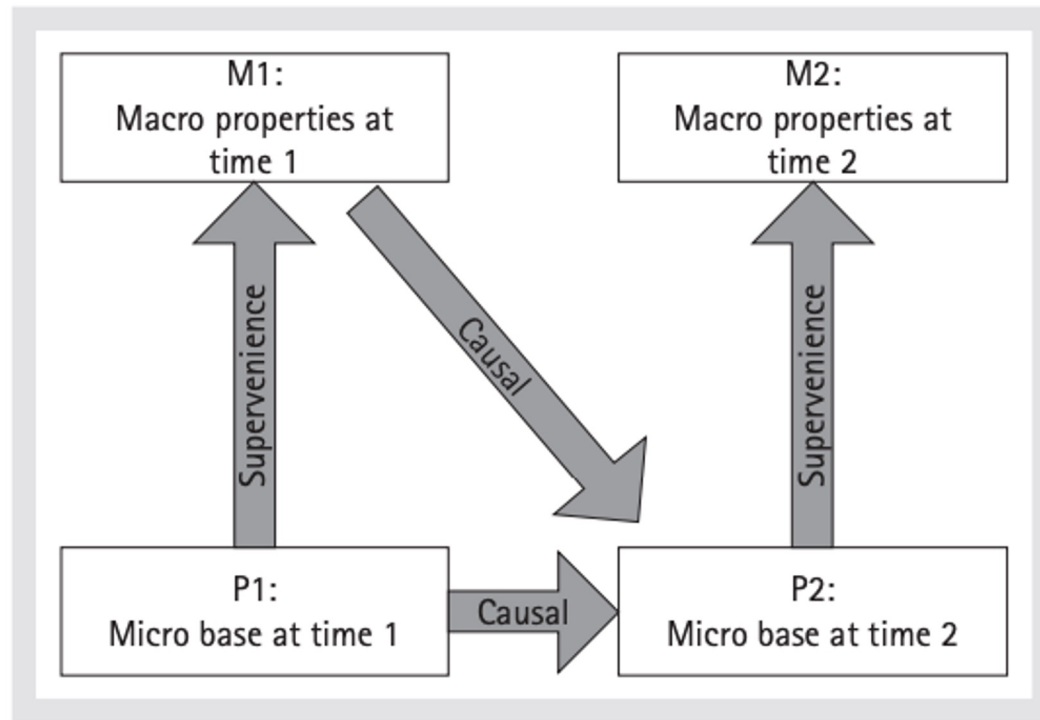
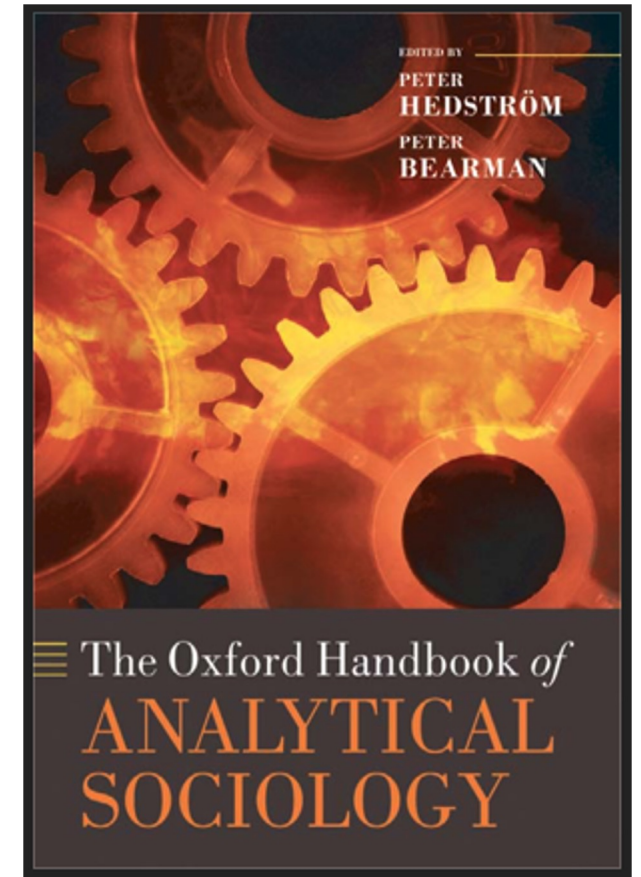


Fig. 1.2 Macro dynamics from a supervenience perspective



I. How Should We Do Social Science?

- Complexity Science

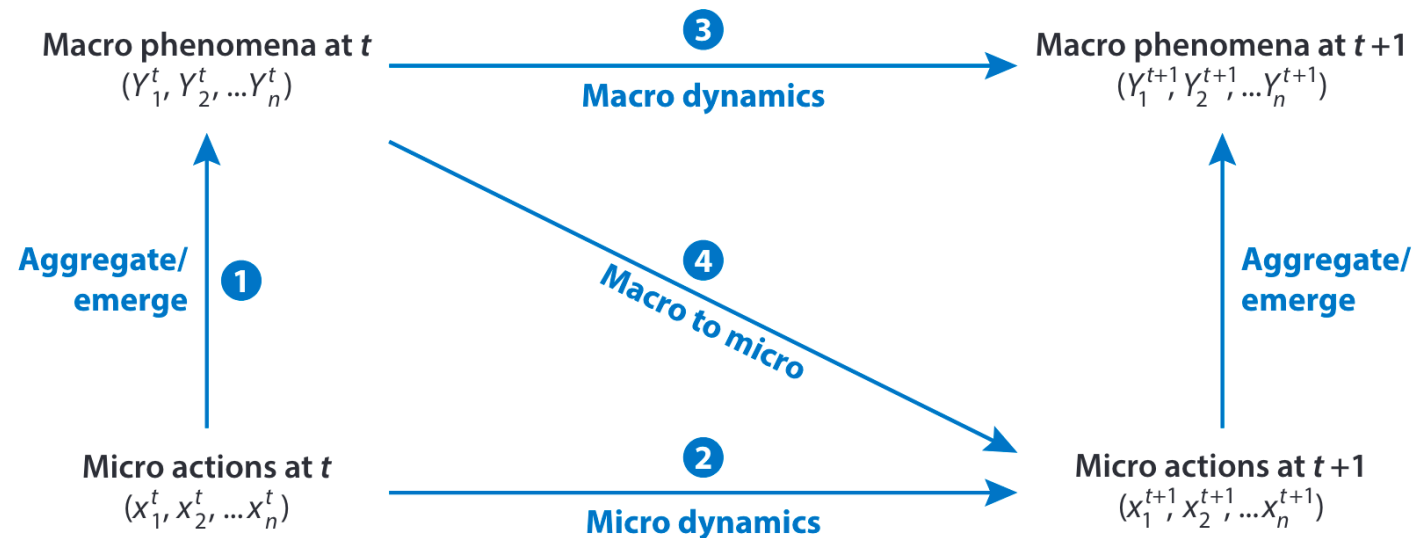
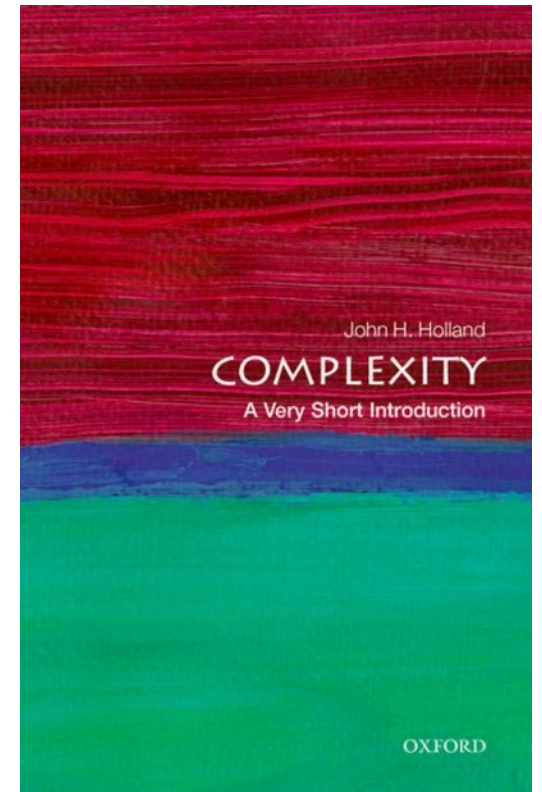
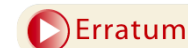
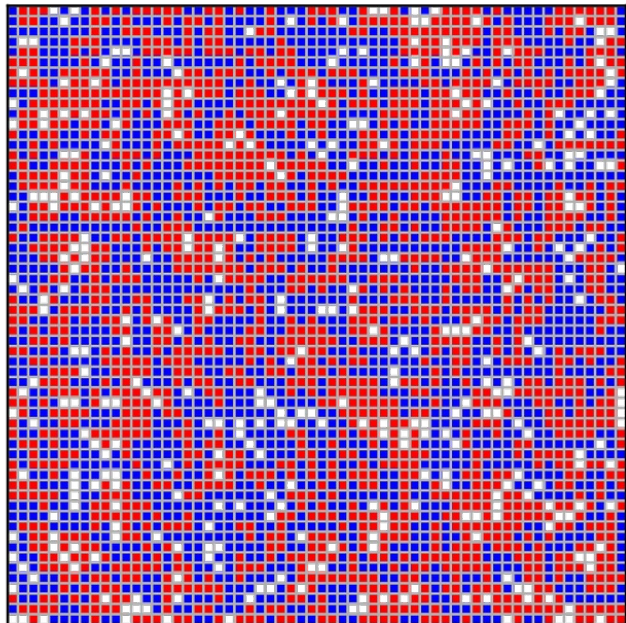


Figure 2

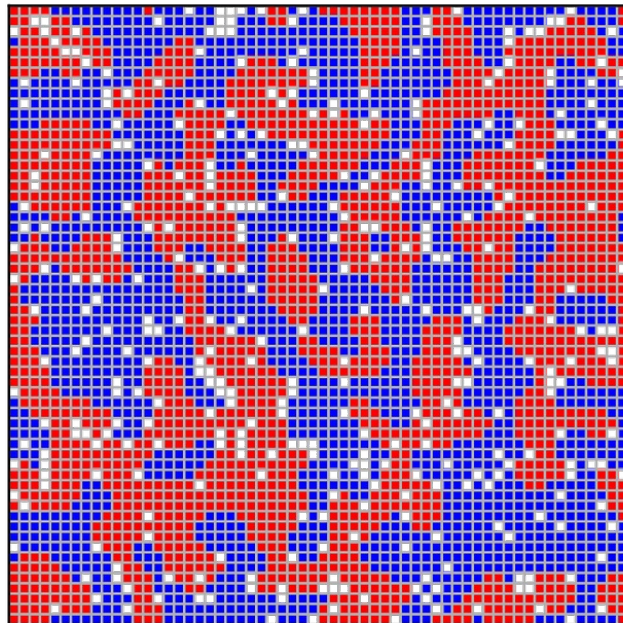
The aggregation diagram.



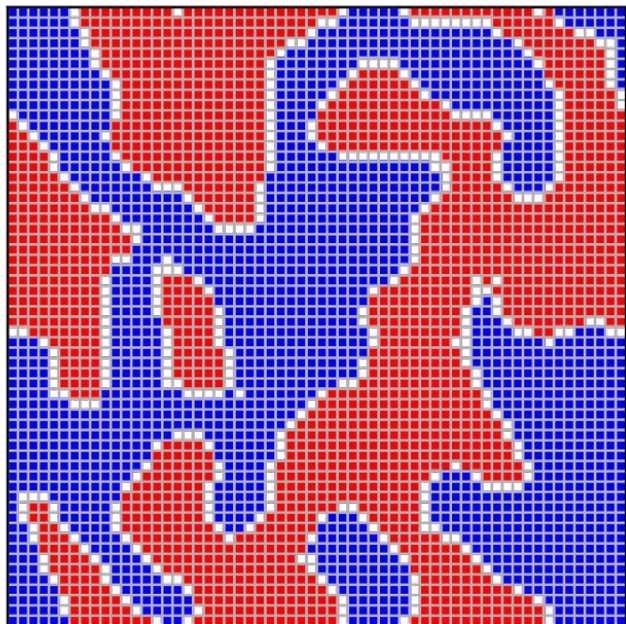
$$1 - \tau = 0.25$$



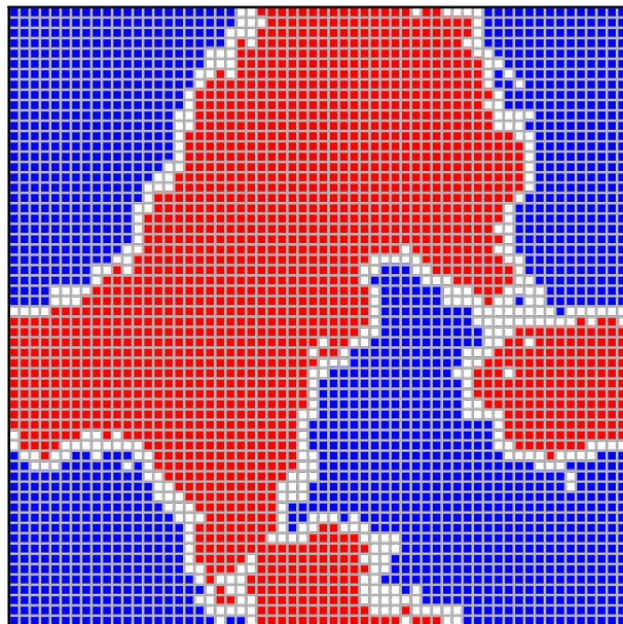
$$1 - \tau = 0.4$$



$$1 - \tau = 0.6$$



$$1 - \tau = 0.75$$



I. How Should We Do Social Science?

- “Mathematical sociology should be the grail that we are searching for—it may be a myth, but if we stop believing that there are mathematical properties of social interaction, we should leave off all this number crunching,” (Martin 2018:27).

II. One Model of Worship Attendance

- First, theoretical assumptions...
- Second, outcomes of these assumptions...
- Third, insight into process...
- Imagine a world...

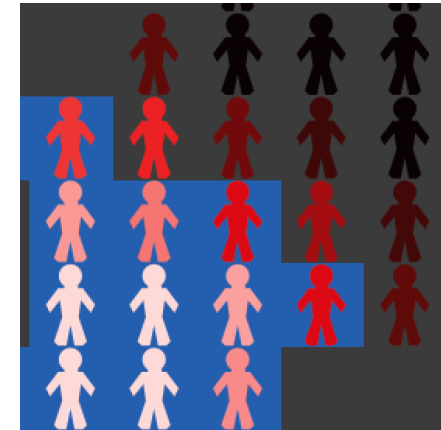
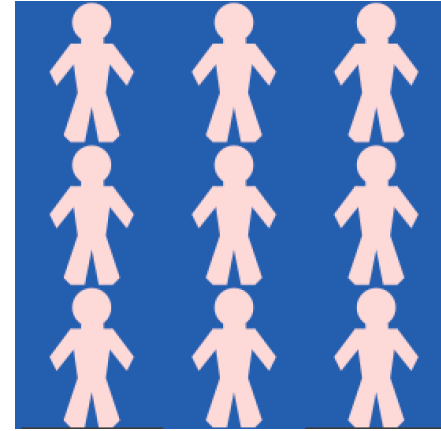
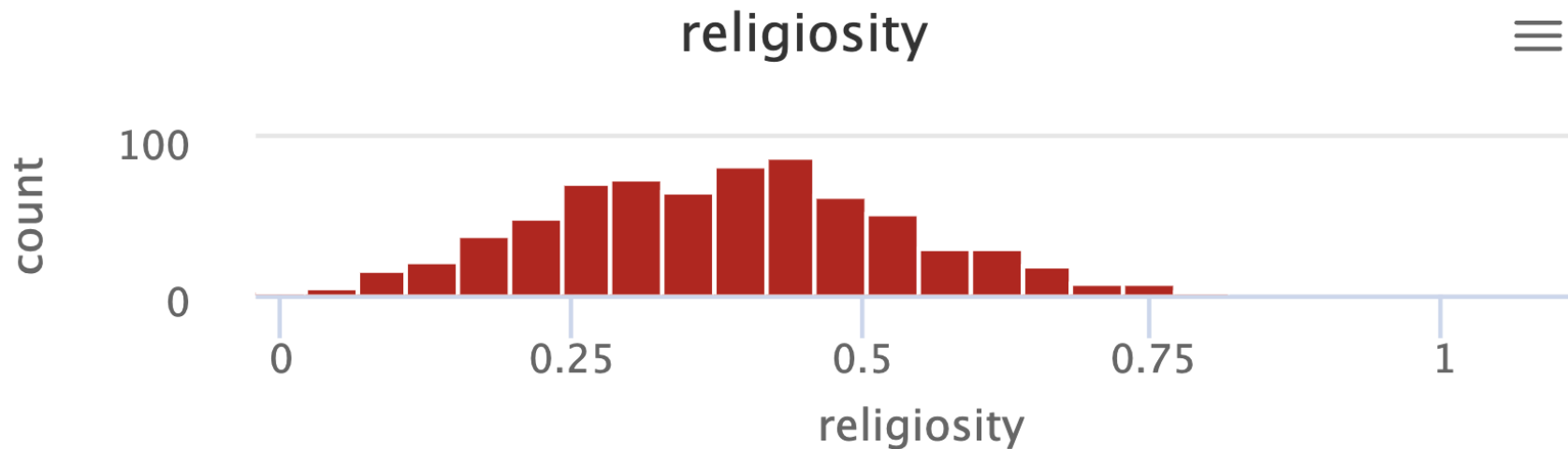
II. One Model of Worship Attendance

- *worship desire* = social factors + individual factors
- *worship desire* = network attendance + individual religiosity
- *worship desire* = (X)network attendance + (1-X)individual religiosity
- *worship desire* = (social influence) * (network attendance) +
(1 – social influence) * (individual religiosity)

Three variables...

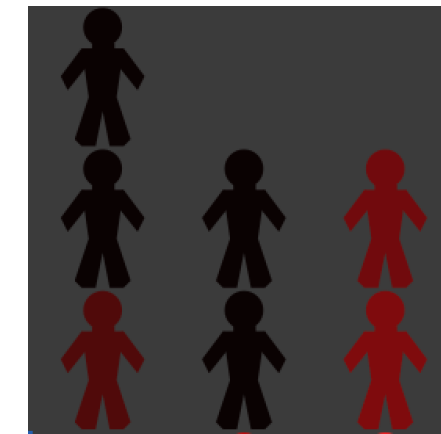
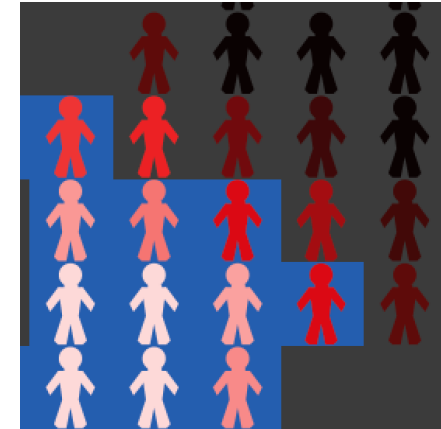
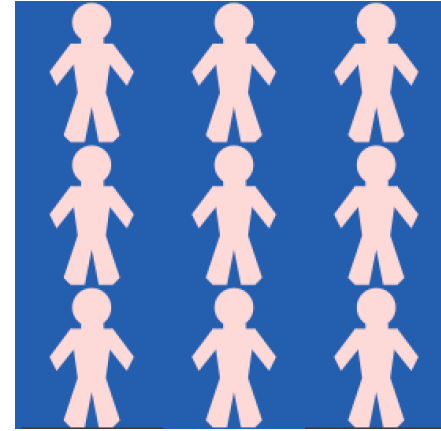
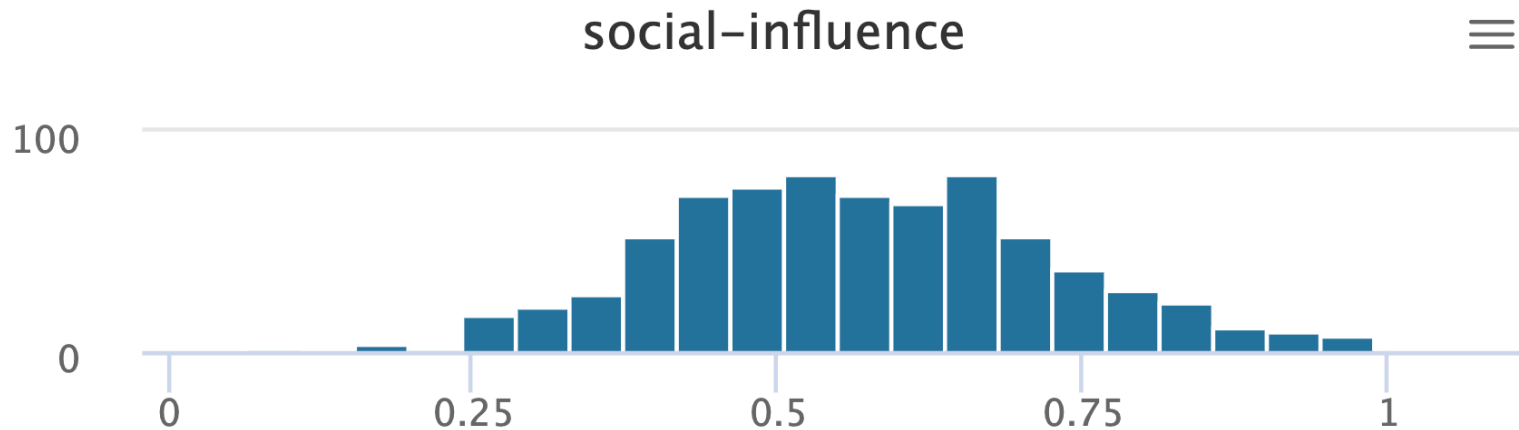
II. One Model of Worship Attendance

- Individual religiosity
 - End result of any and all (individual) factors that lead someone to worship
 - i.e. everything except social network
 - Ranges from 0 – 1 (least religious to most religious; dark to light)
 - Global parameter? Normal distribution? Bi-modal? This is a conjecture...



II. One Model of Worship Attendance

- Social Influence
 - The amount of weight given to social network on decision to worship
 - Ranges from 0 – 1 (stubborn to sheep)
 - Global parameter? Normal distribution? Bi-modal? This is a conjecture...

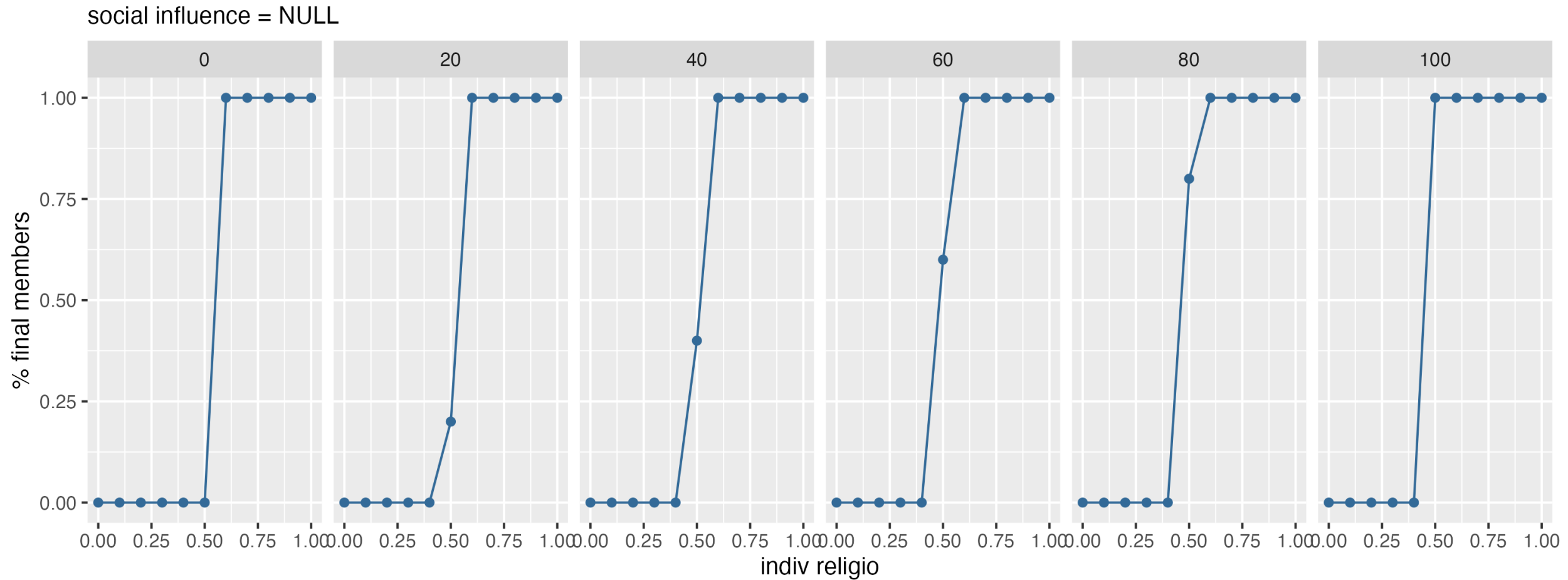


II. One Model of Worship Attendance

$$\text{worship desire} = (\text{social influence}) * (\text{network members}) + \\ (1 - \text{social influence}) * (\text{individual religiosity})$$

WORSHIP DESIRE	ATTEND	NON-ATTEND
$D > 0.6$	stay	join
$D \text{ } 0.4 - 0.6$	stay	stay
$D < 0.4$	leave	stay

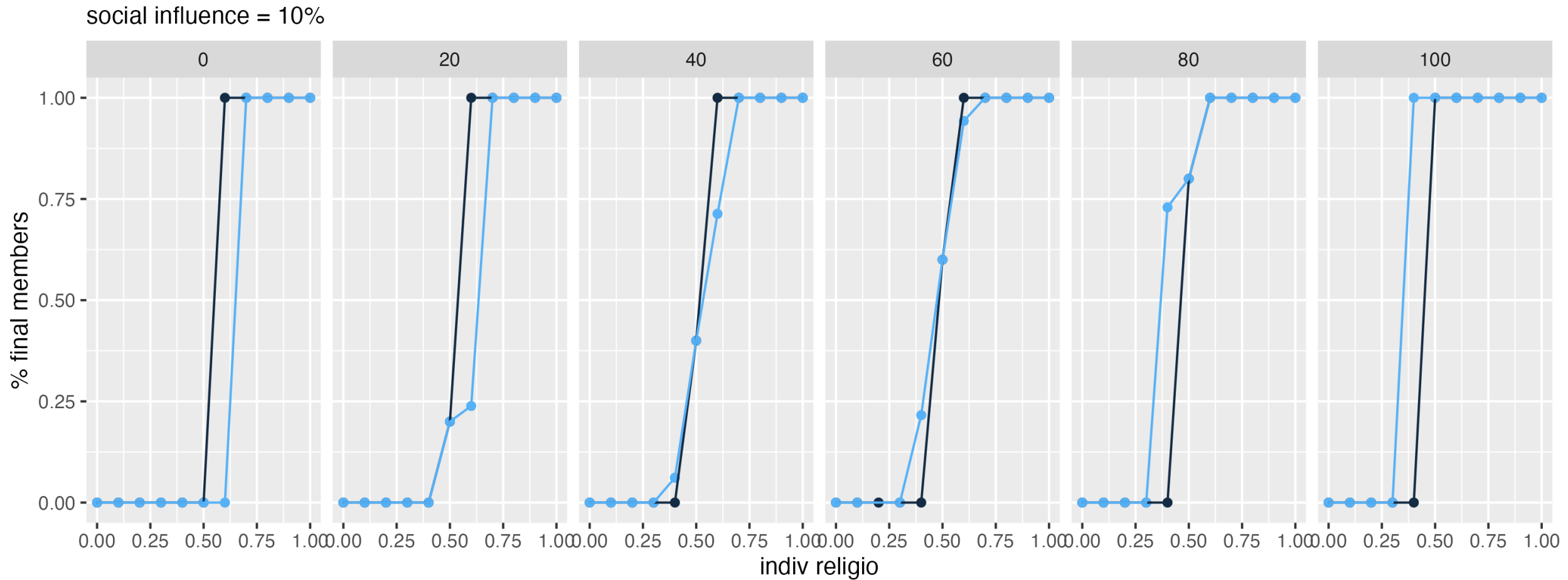
II. One Model of Worship Attendance



Note: global values

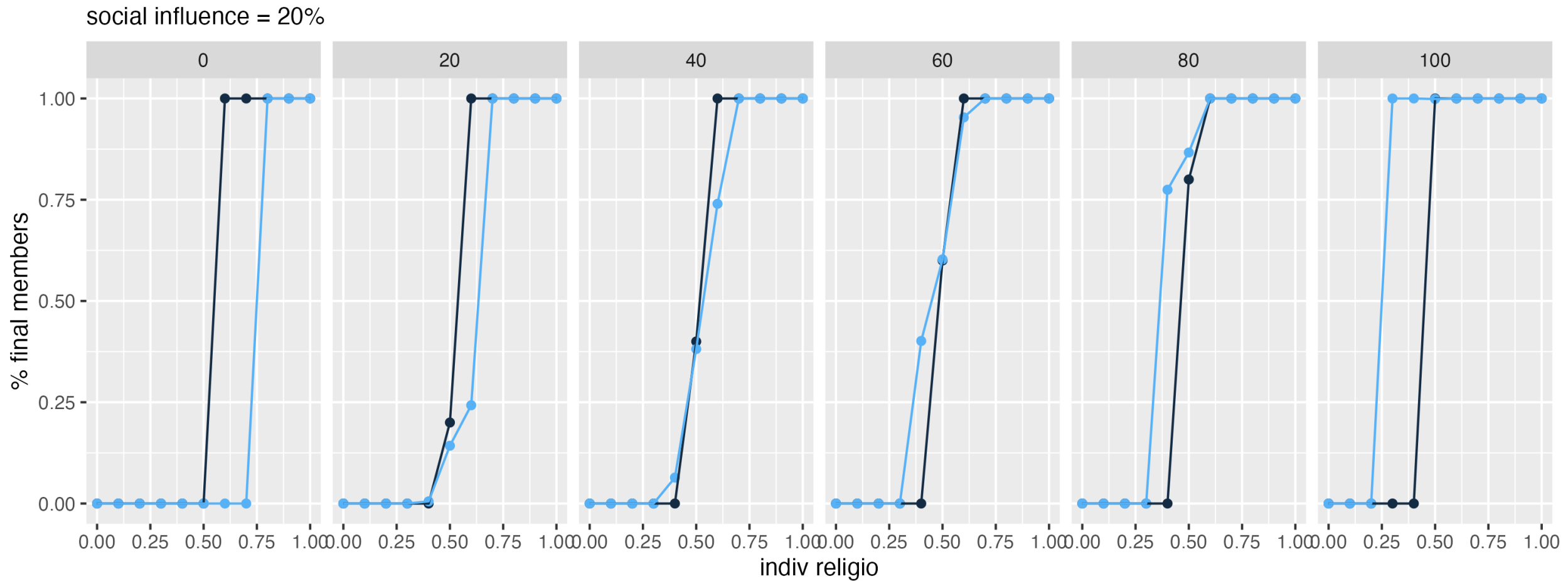
Note: Top value is starting attendance rate in community, y axis is final attendance rate, x-axis is individual religiosity

II. One Model of Worship Attendance



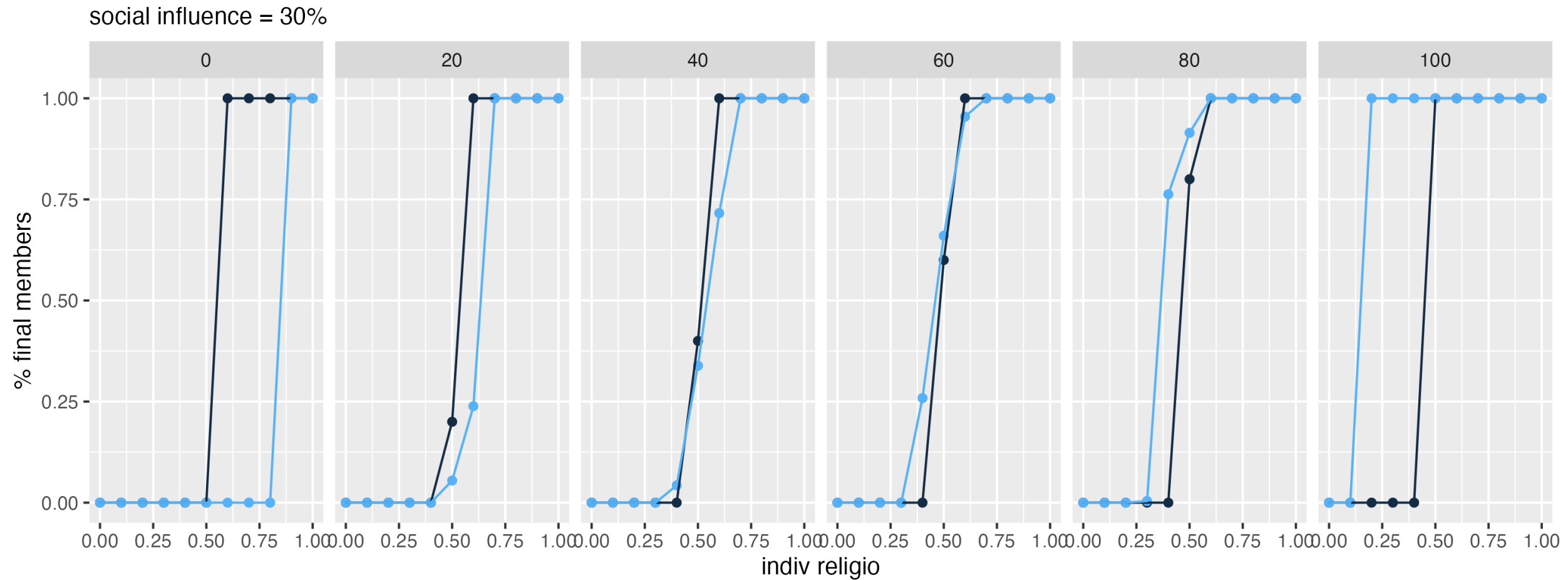
Note: global values

II. One Model of Worship Attendance



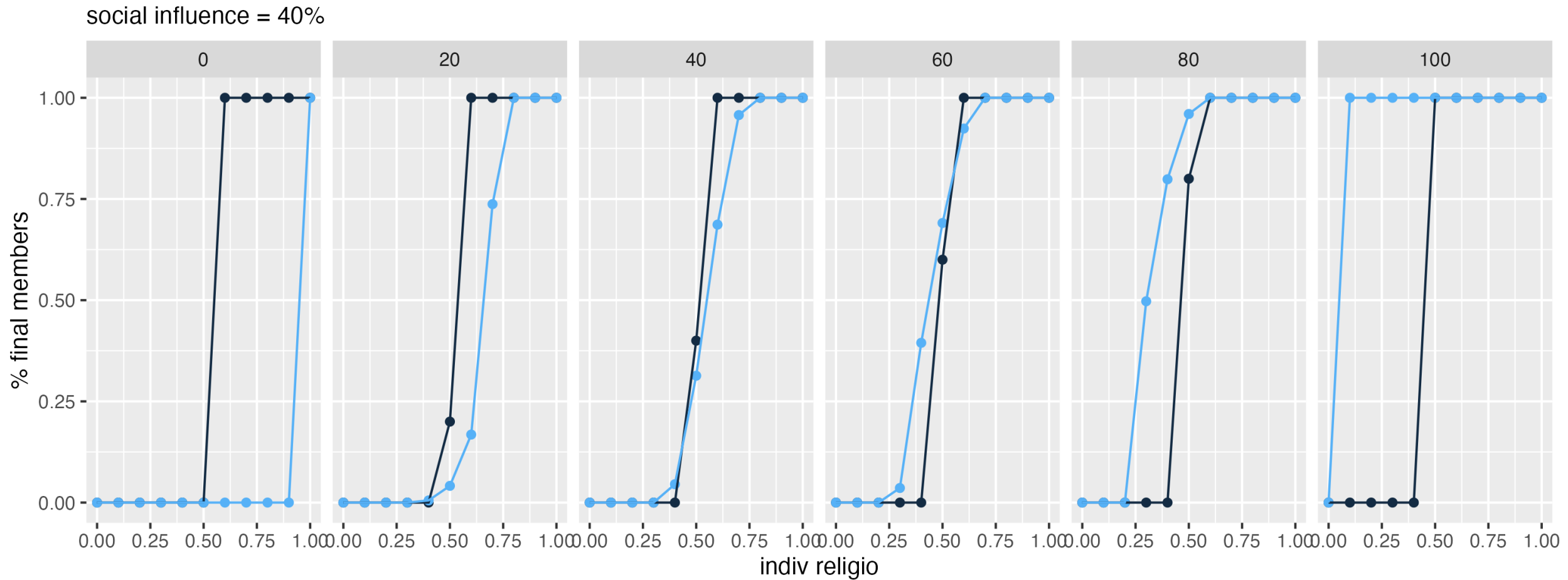
Note: global values

II. One Model of Worship Attendance



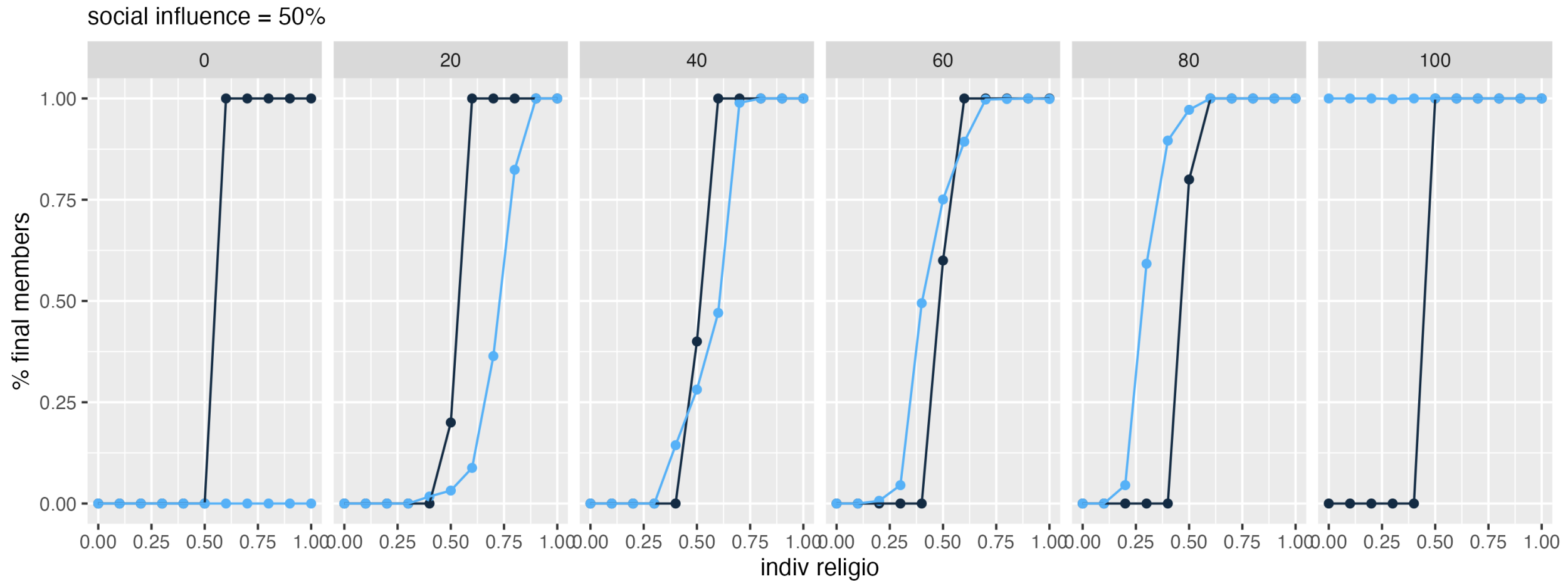
Note: global values

II. One Model of Worship Attendance



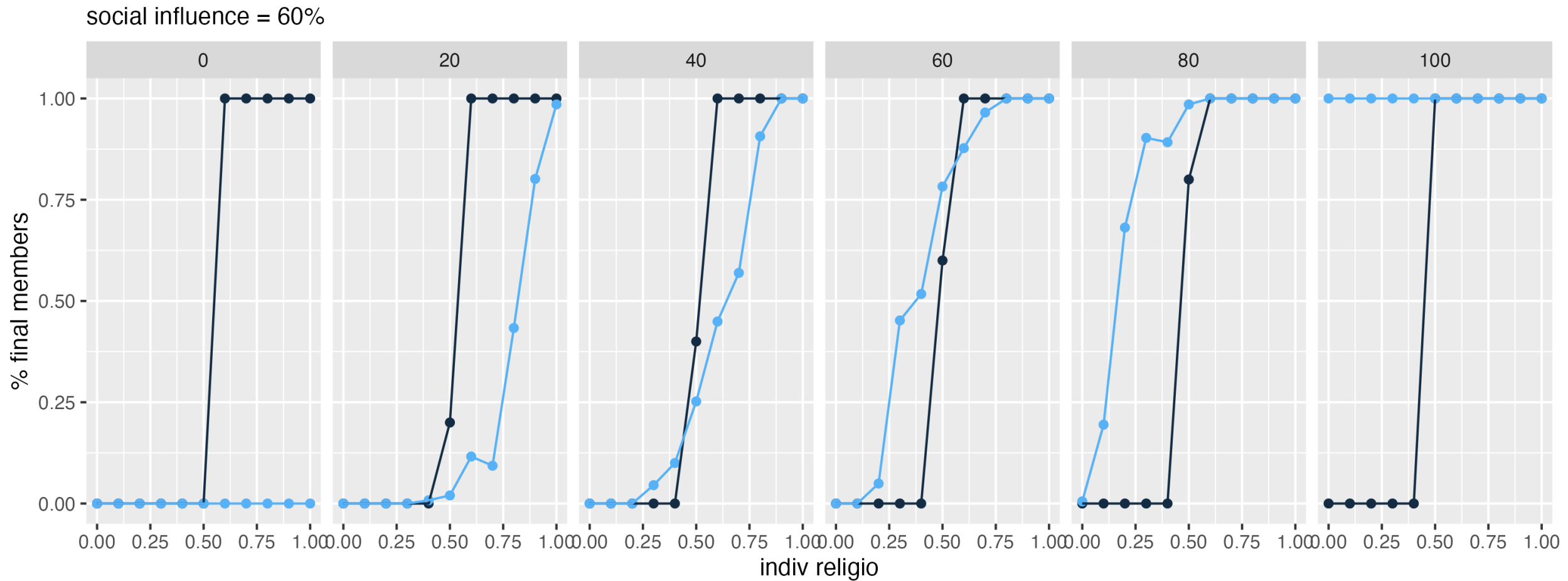
Note: global values

II. One Model of Worship Attendance



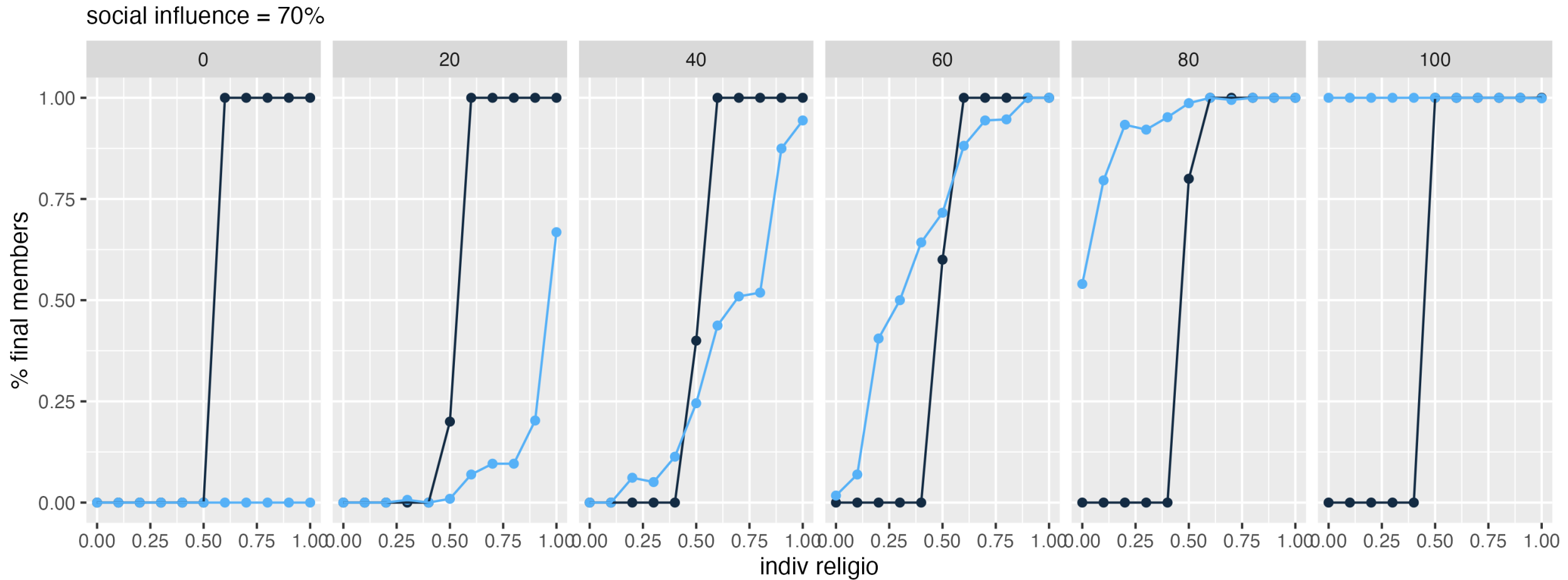
Note: global values

II. One Model of Worship Attendance



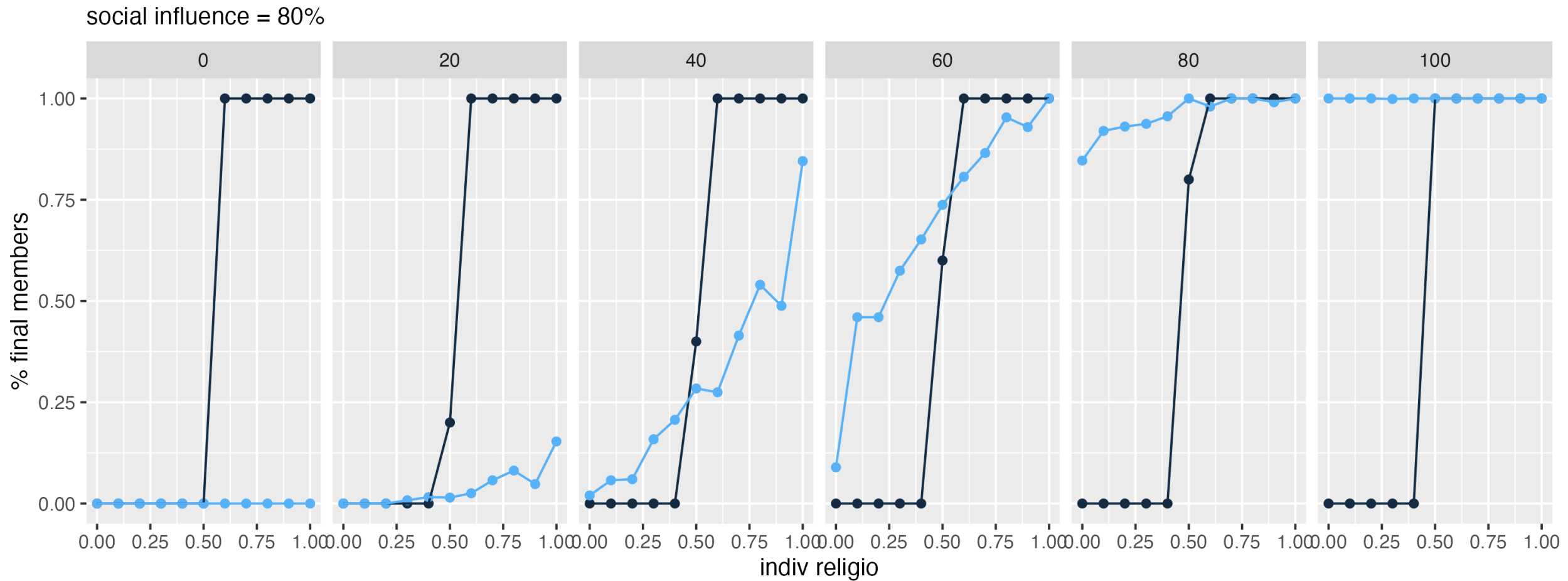
Note: global values

II. One Model of Worship Attendance



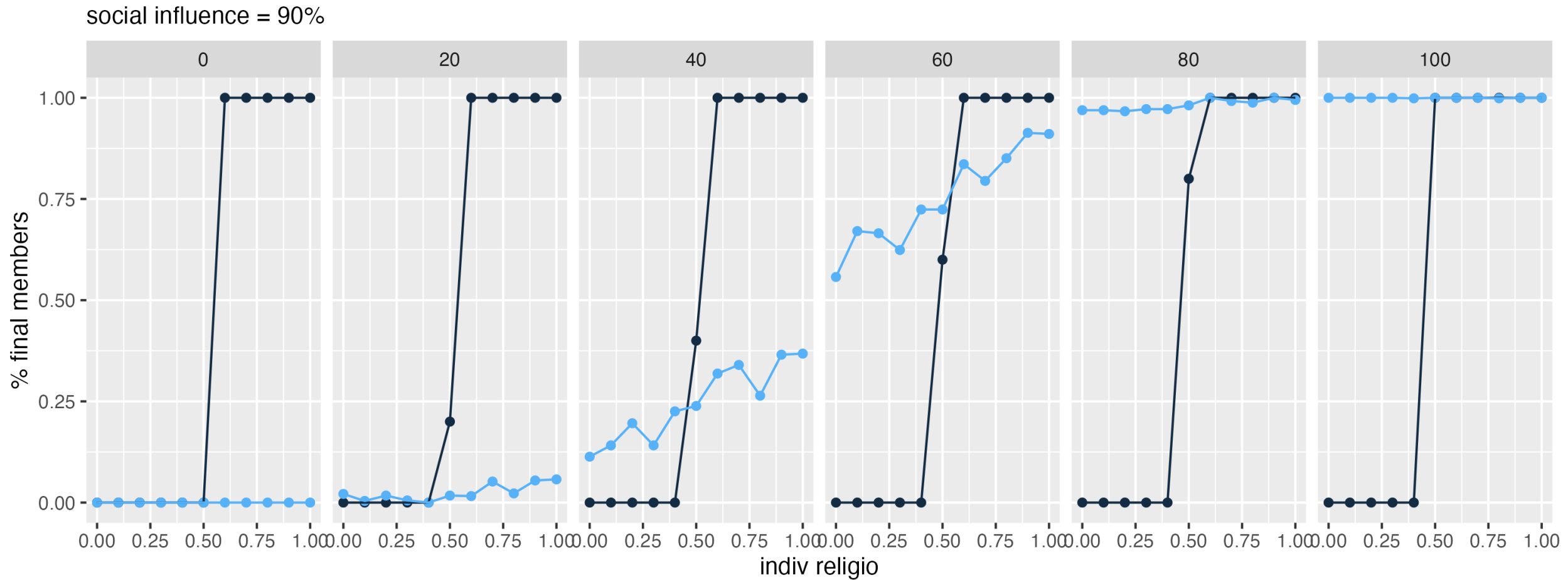
Note: global values

II. One Model of Worship Attendance



Note: global values

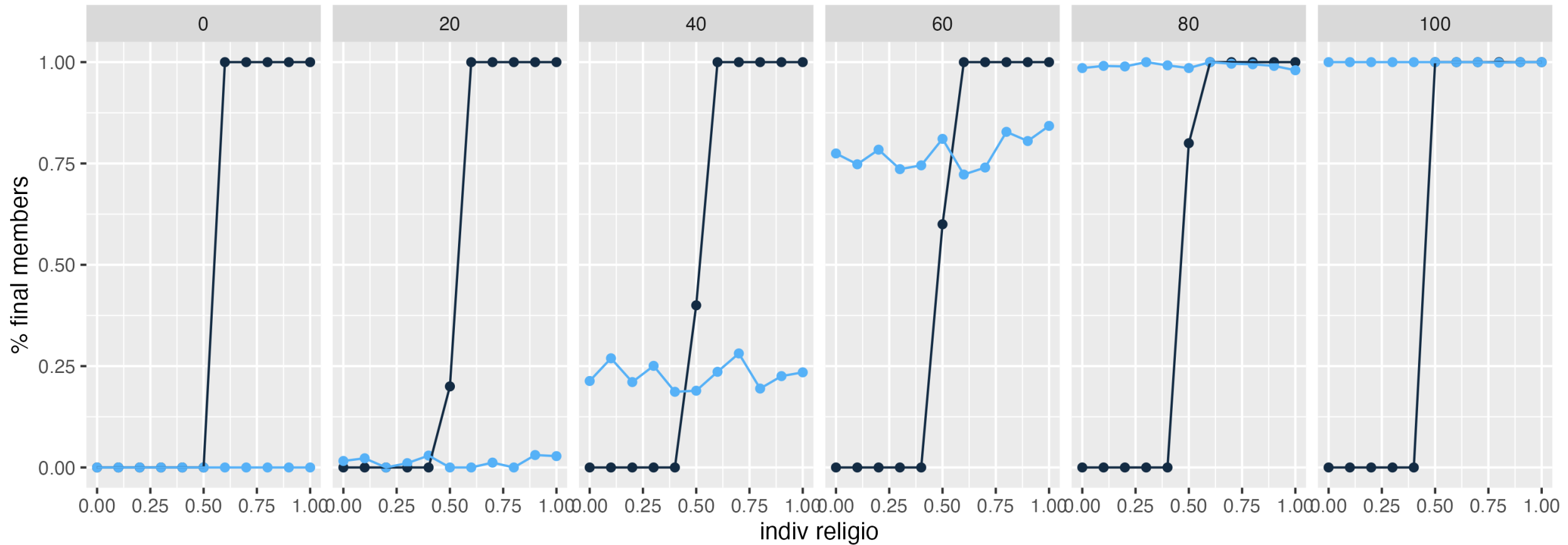
II. One Model of Worship Attendance



Note: global values

II. One Model of Worship Attendance

social influence = 100%

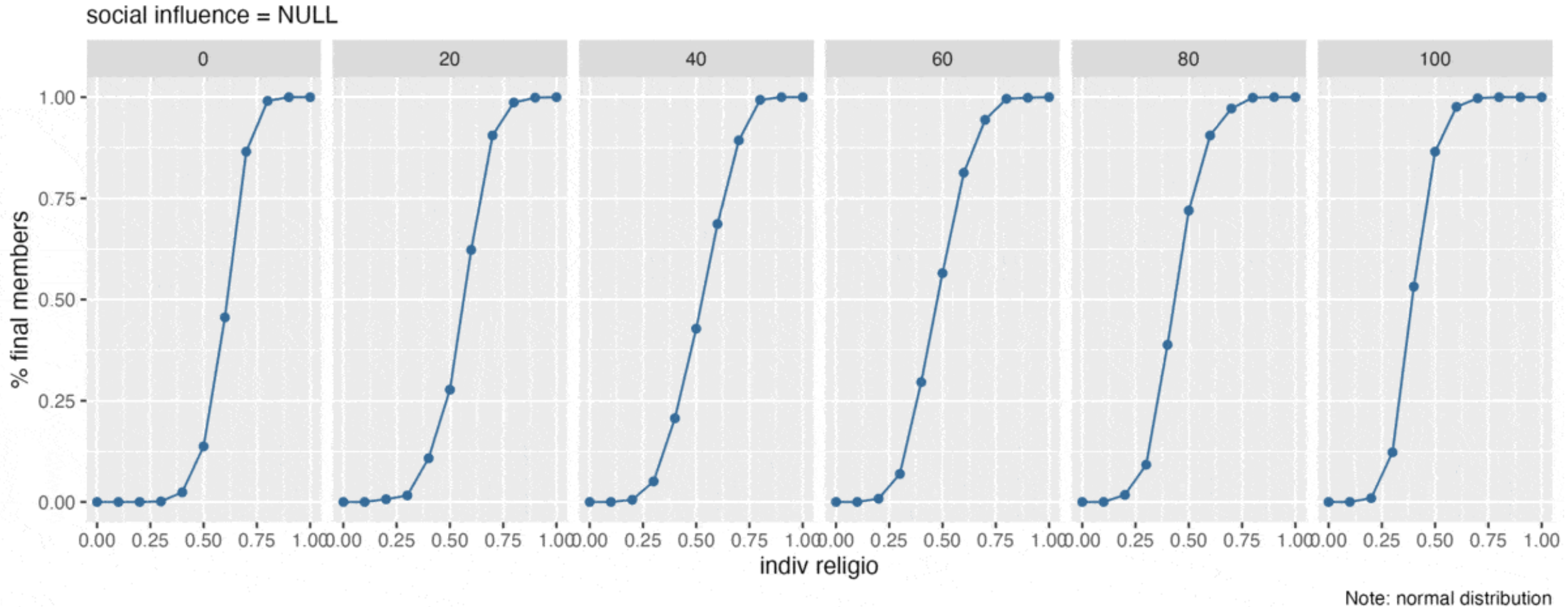


Note: global values

II. One Model of Worship Attendance

Now allowing each parameter to vary according to normal distribution (individual religiosity and social influence)

II. One Model of Worship Attendance

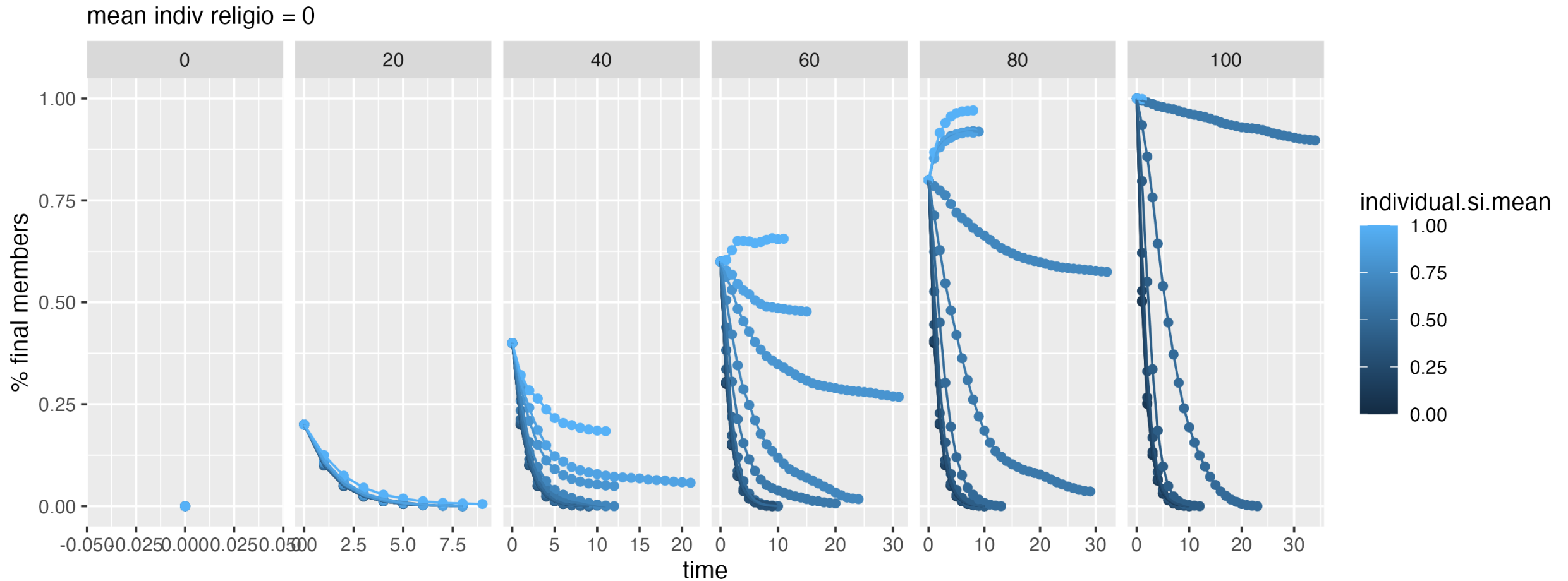


Note: Top value is starting attendance rate in community, y axis is final attendance rate, x-axis is individual religiosity

II. One Model of Worship Attendance

- ABM shed light on dynamic process, not just start / end states.
- Attendance trends for 600 different simulated communities...
- Examine five “case studies”

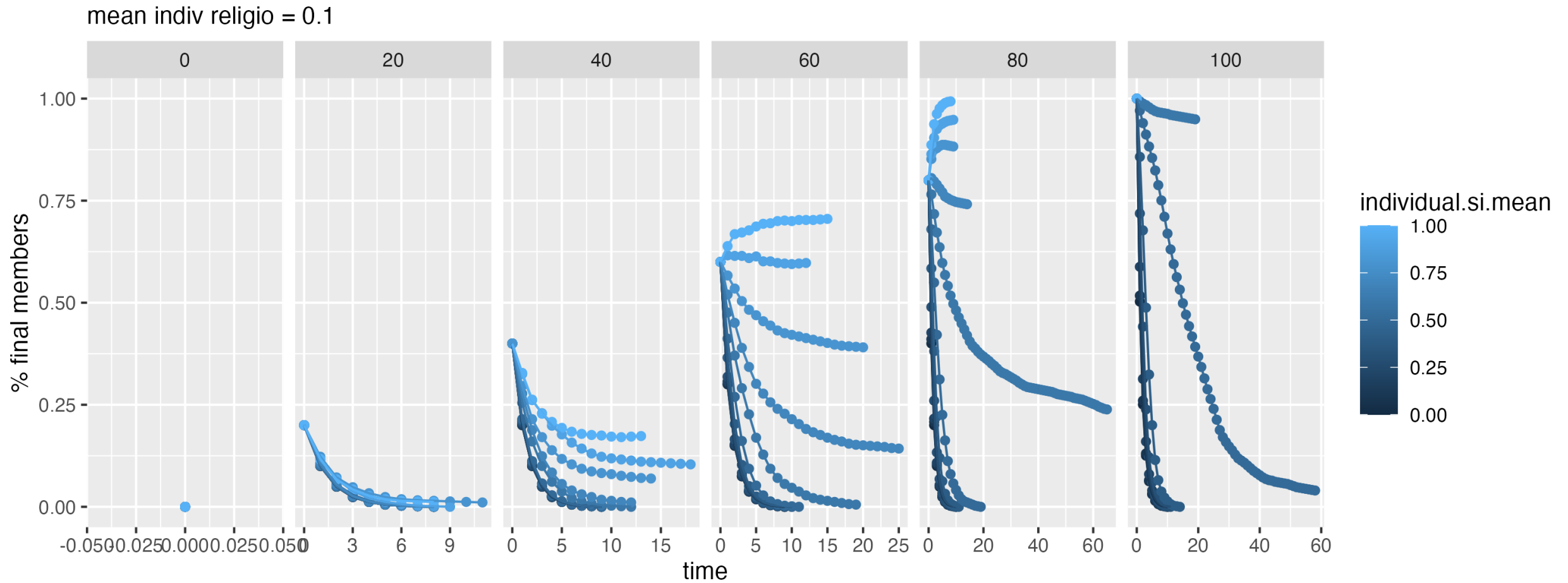
II. One Model of Worship Attendance



Note: normal distribution

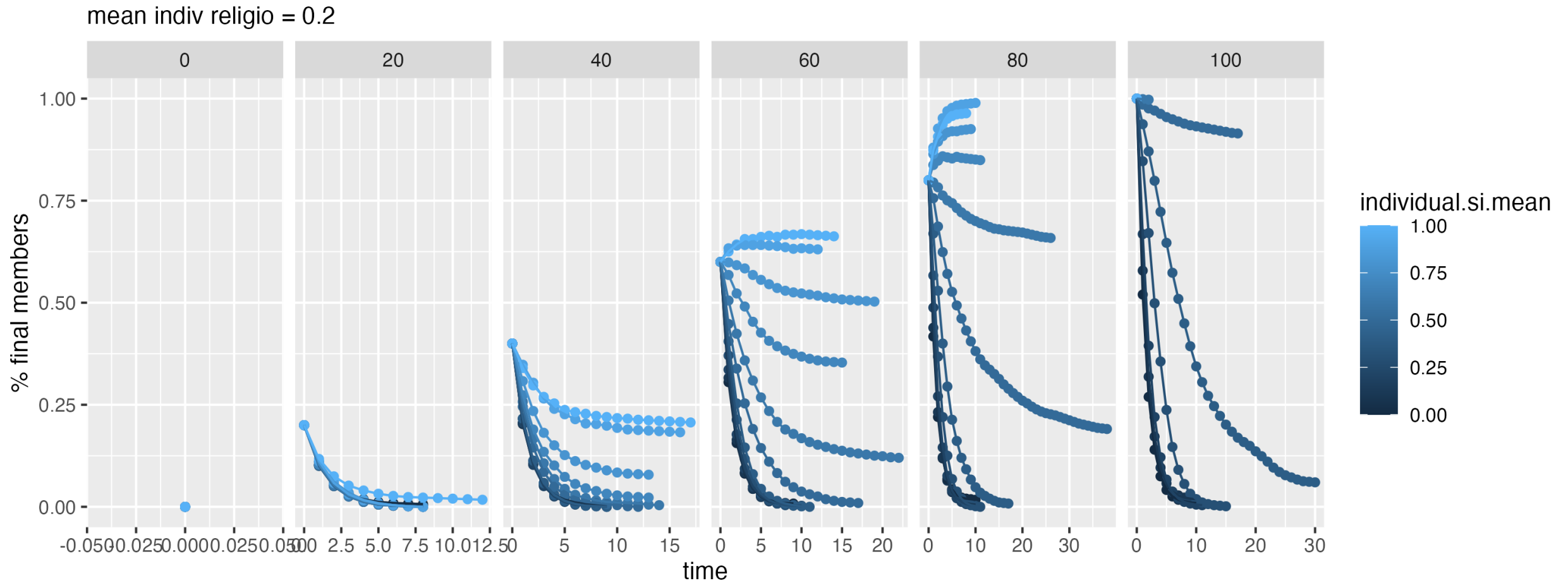
Note: Top value is starting attendance rate in community, y axis is final attendance rate, x-axis shows each step of model

II. One Model of Worship Attendance



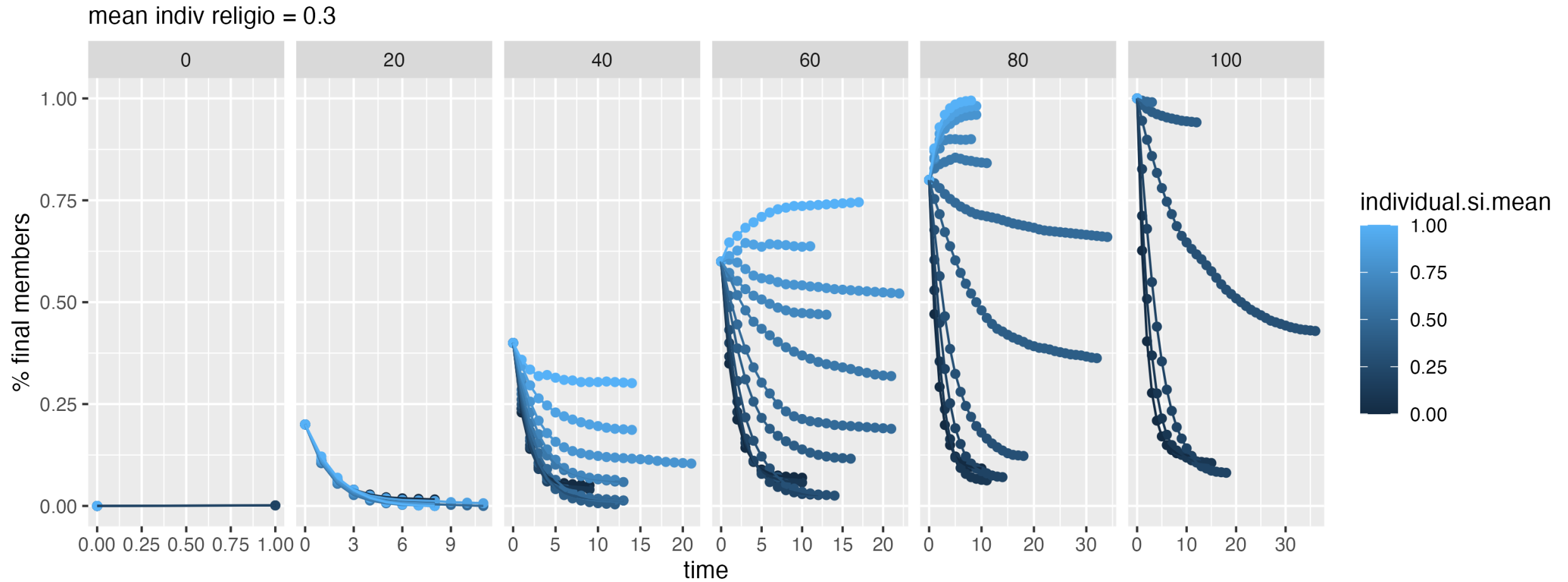
Note: normal distribution

II. One Model of Worship Attendance



Note: normal distribution

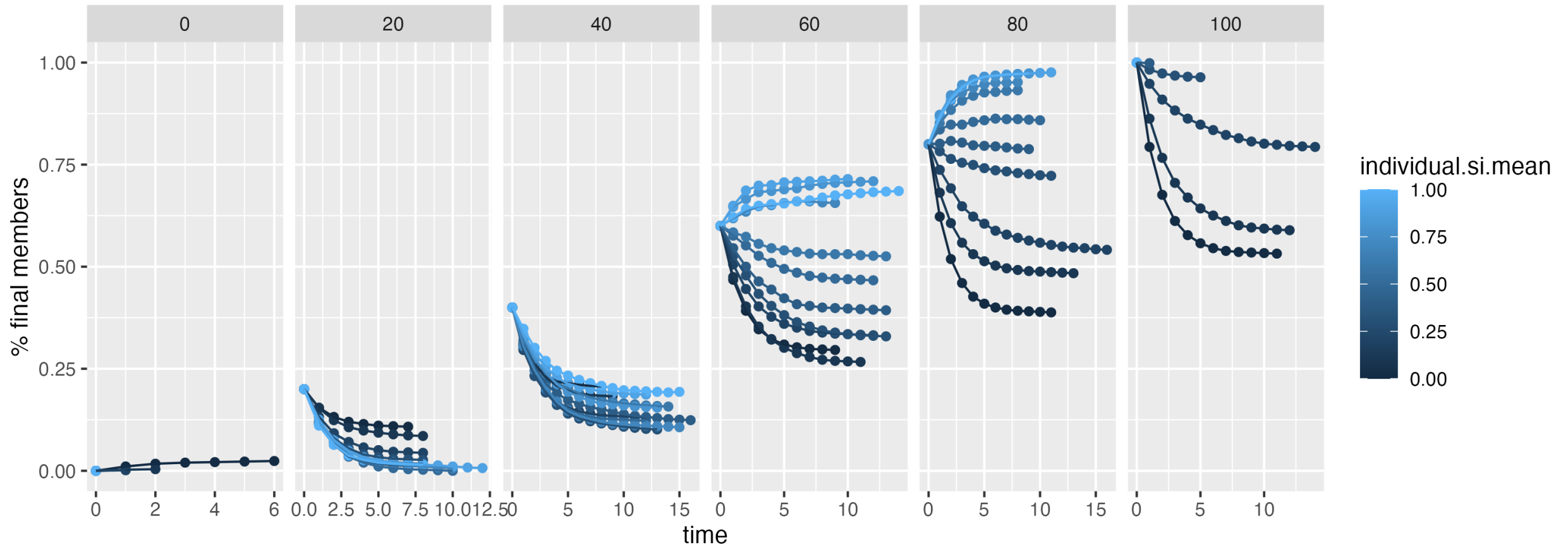
II. One Model of Worship Attendance



Note: normal distribution

II. One Model of Worship Attendance

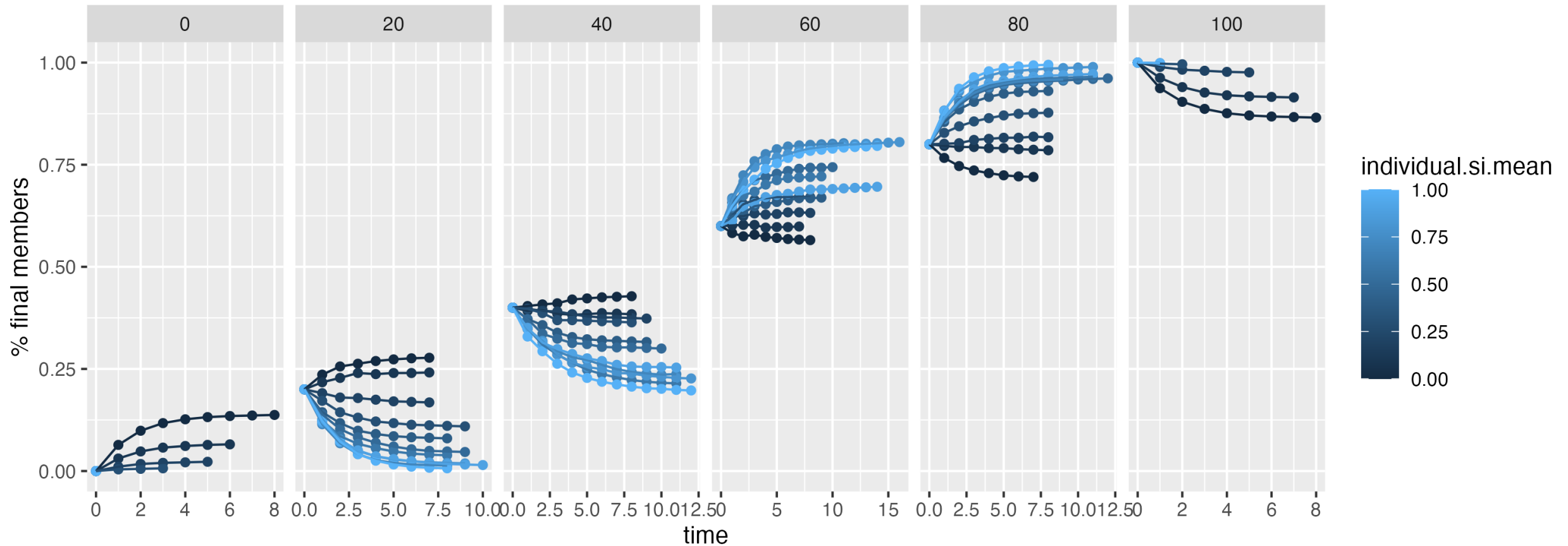
mean indiv religio = 0.4



Note: normal distribution

II. One Model of Worship Attendance

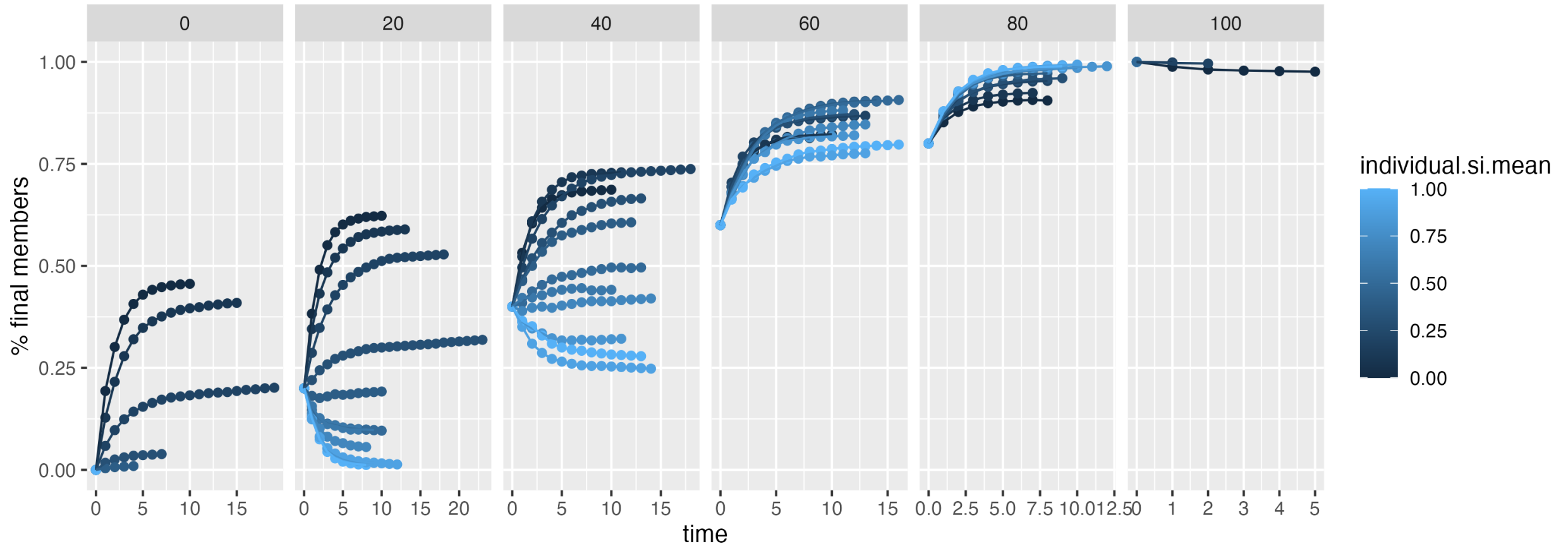
mean indiv religio = 0.5



Note: normal distribution

II. One Model of Worship Attendance

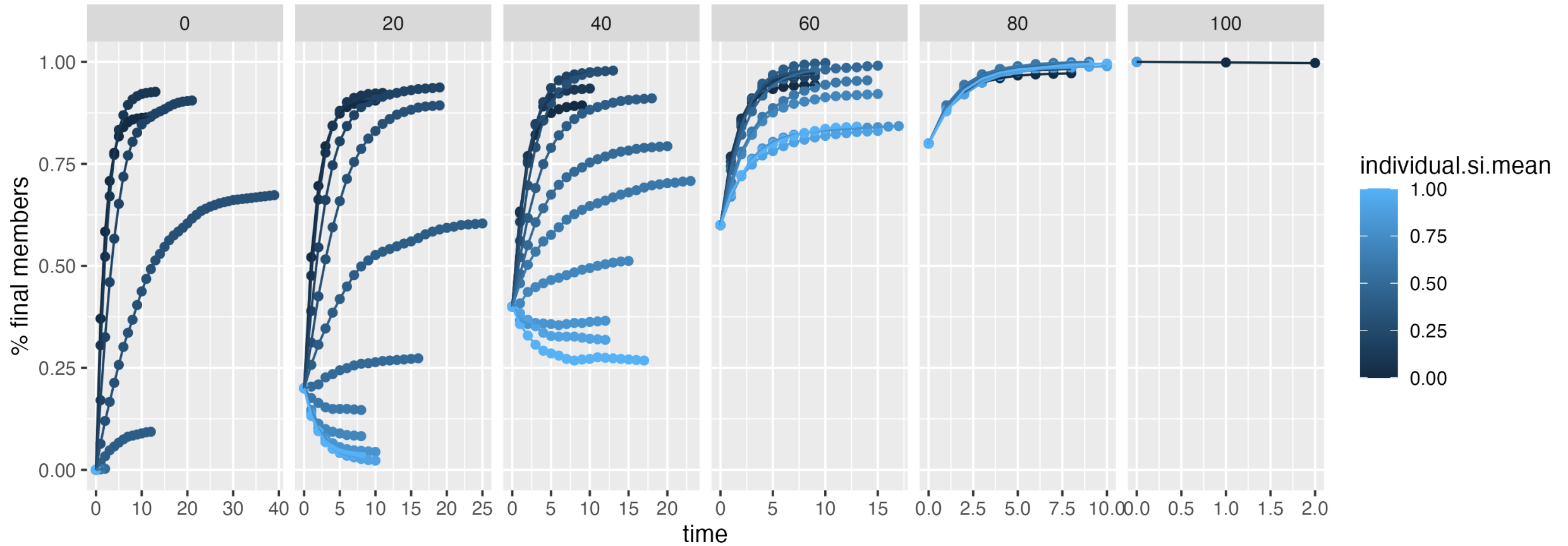
mean indiv religio = 0.6



Note: normal distribution

II. One Model of Worship Attendance

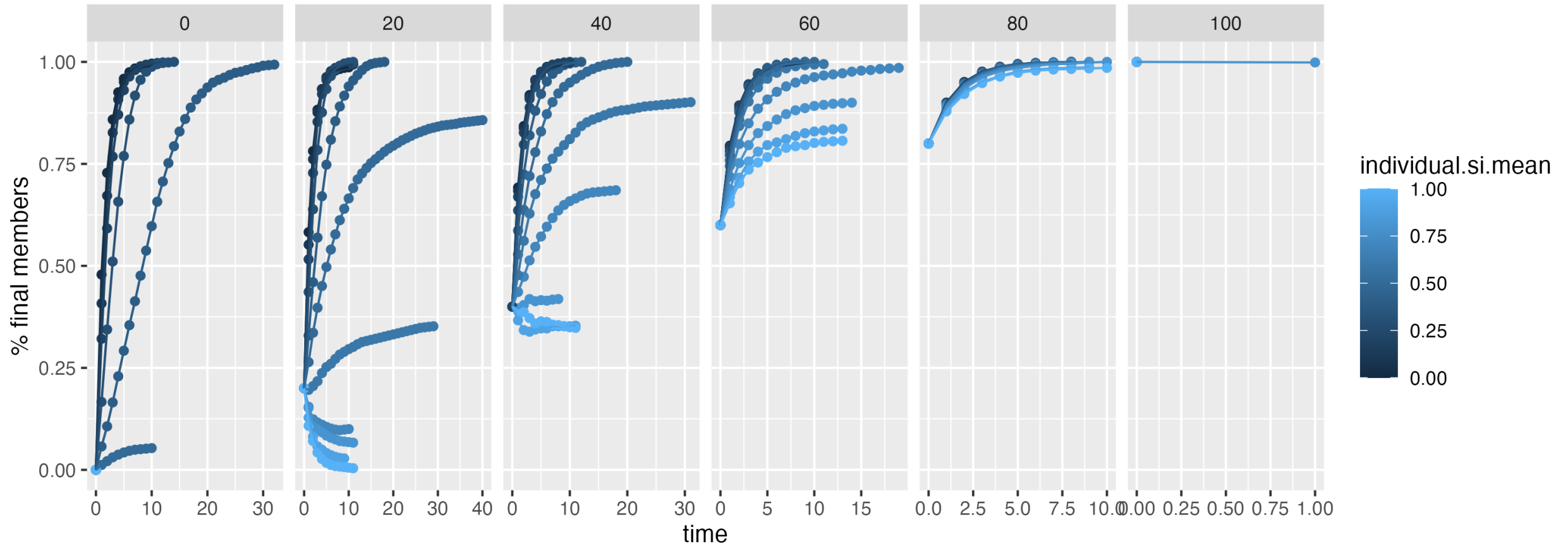
mean indiv religio = 0.7



Note: normal distribution

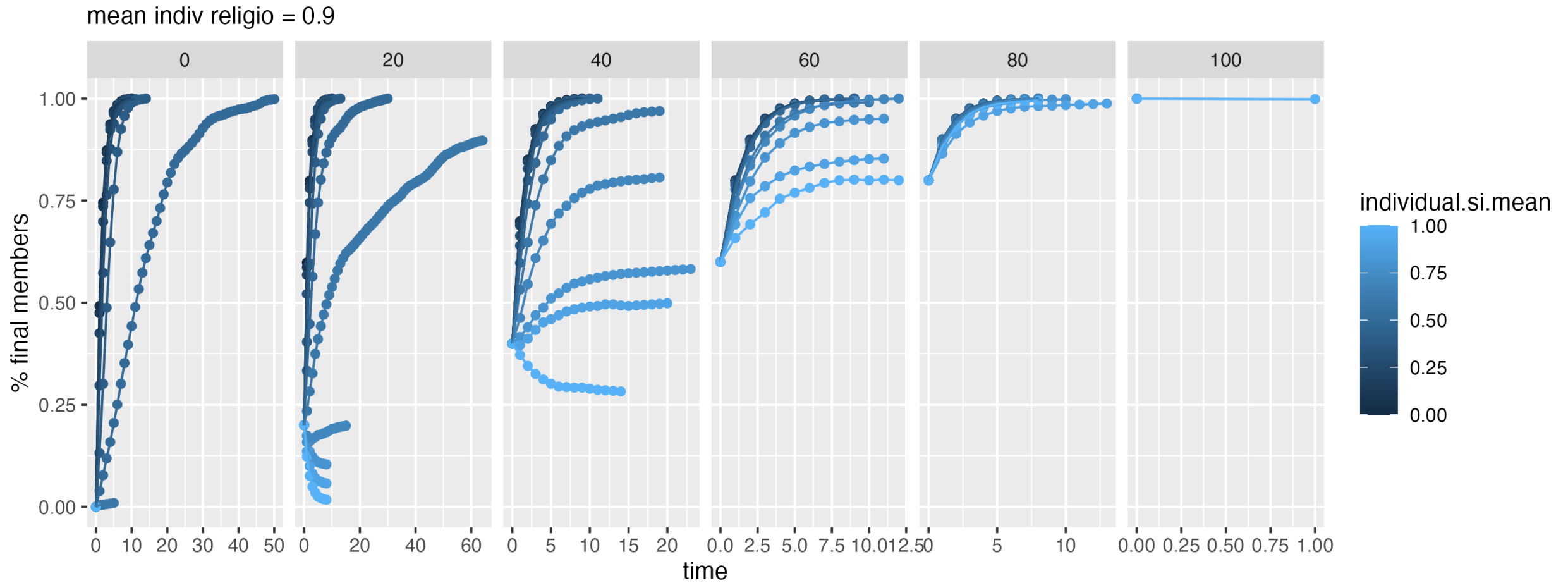
II. One Model of Worship Attendance

mean indiv religio = 0.8



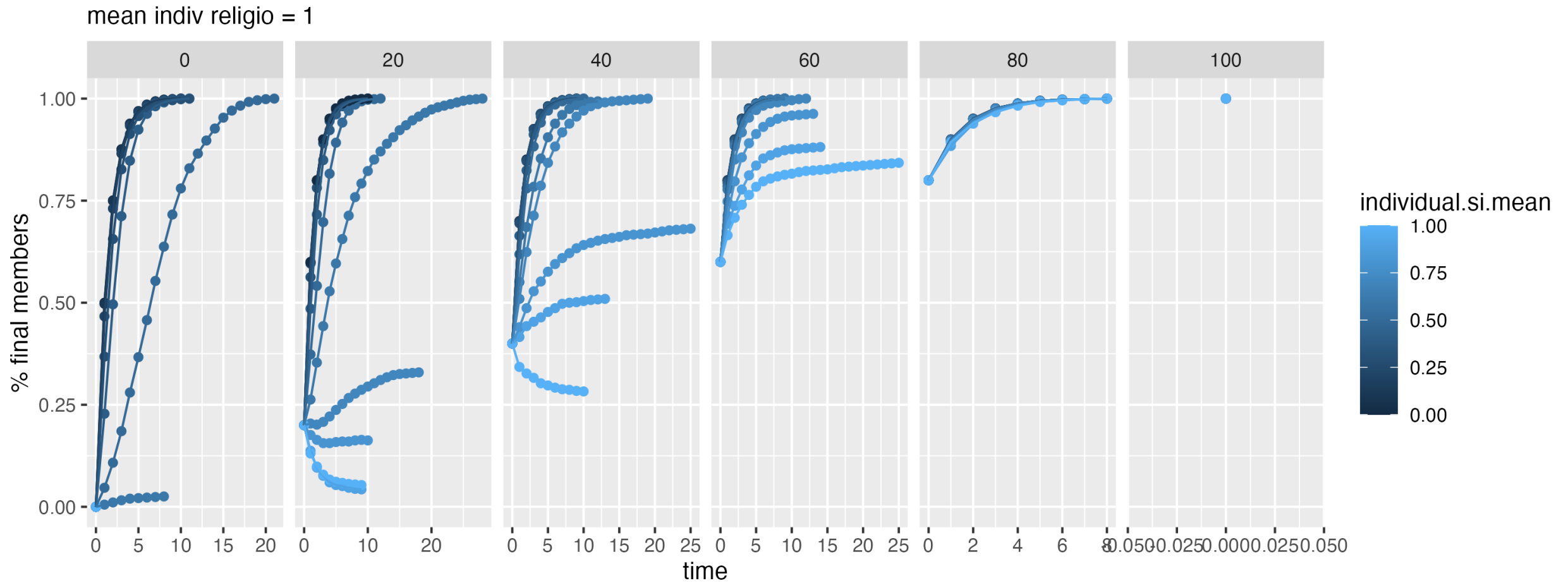
Note: normal distribution

II. One Model of Worship Attendance



Note: normal distribution

II. One Model of Worship Attendance



Note: normal distribution

IV. Some Tentative Conclusions

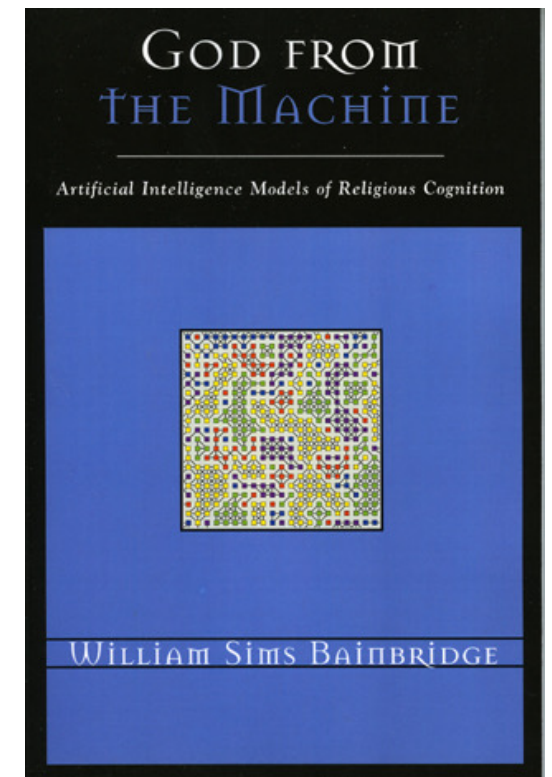
- The chaos of complex systems... Greek's "aporia"
- Even this simple social system (3 vars) produces unexpected (endogenous) effects
- In the midst of a 200-year process of secularization, the pandemic closes ALL churches...
- Adding exogenous effects...

IV. Some Tentative Conclusions

- This is all made up... But which world do we live in?
- Social influence pulls people towards averages
- Some combinations are fraught, others are stable (60 cycles vs. 6 cycles)

IV. Future Directions

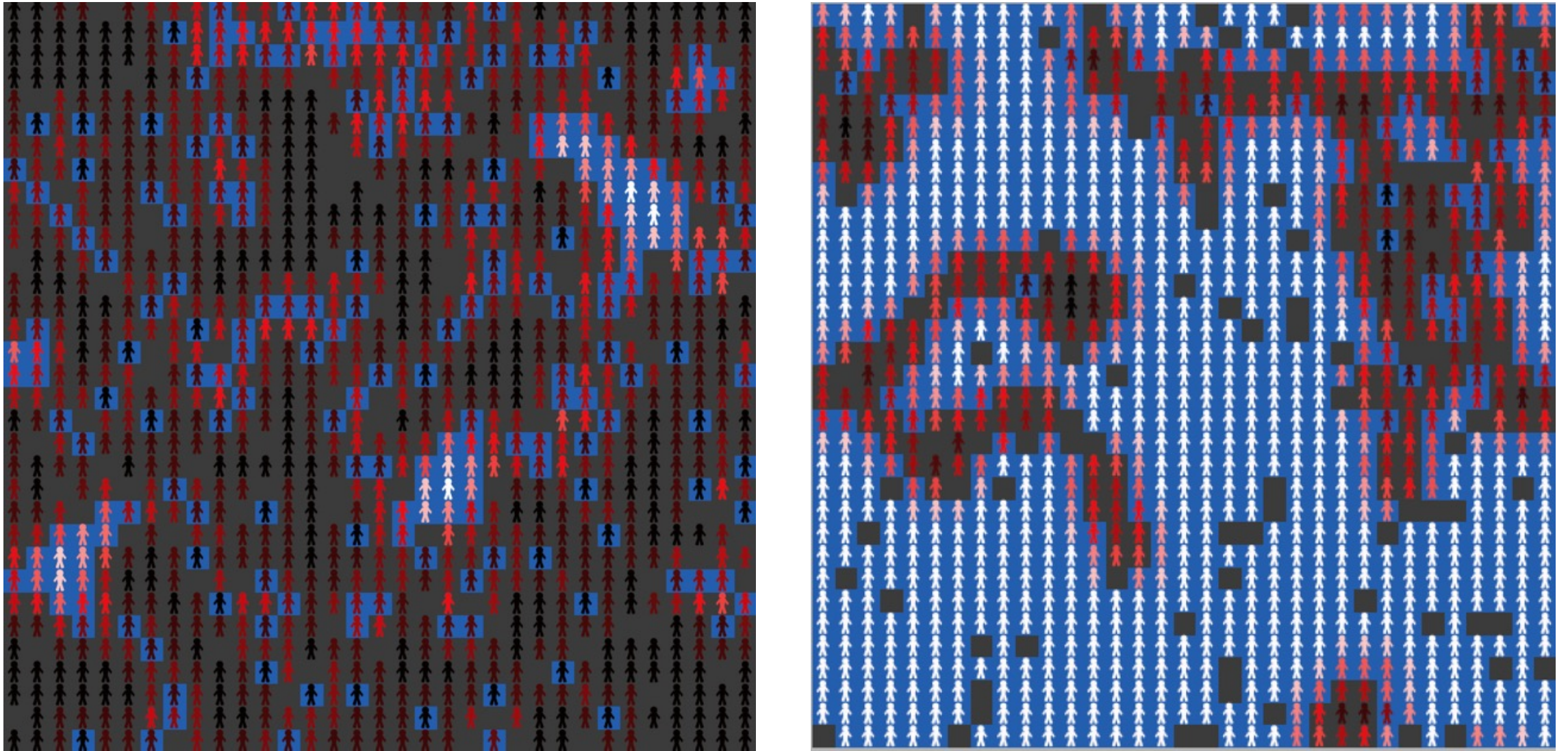
- Use real data as initialization parameters to predict (effects of causes)
- Use real data as end-state validation (causes of effects)
- Popular with religious economy, “new paradigm” folks... But how would secularization theory use these techniques:
 - Adding individualism? Each cycle more weight given to indiv.?
 - Agents aware of global attendance?
 - Fertility as biggest cross-current of secularization, cohort replacement vs. switching
- Adding meso (organizational) and macro (cultural) factors?
- Adding exogenous period effects (pandemic, scandals, politics)
- Agent memory: how many conversions will one person have?
- Dynamic networks, high-value others
- Dense vs. sparse networks



Thank you

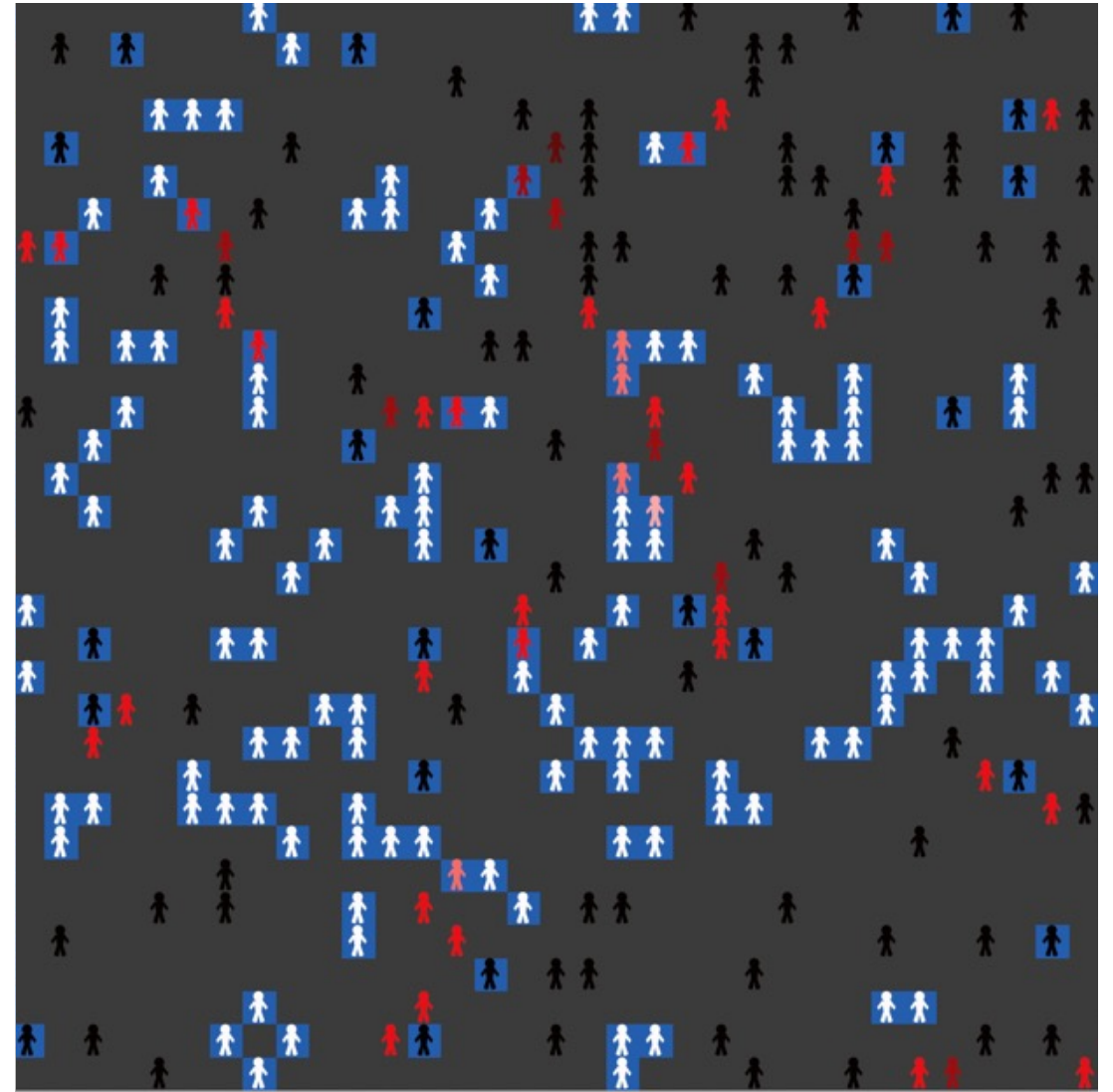
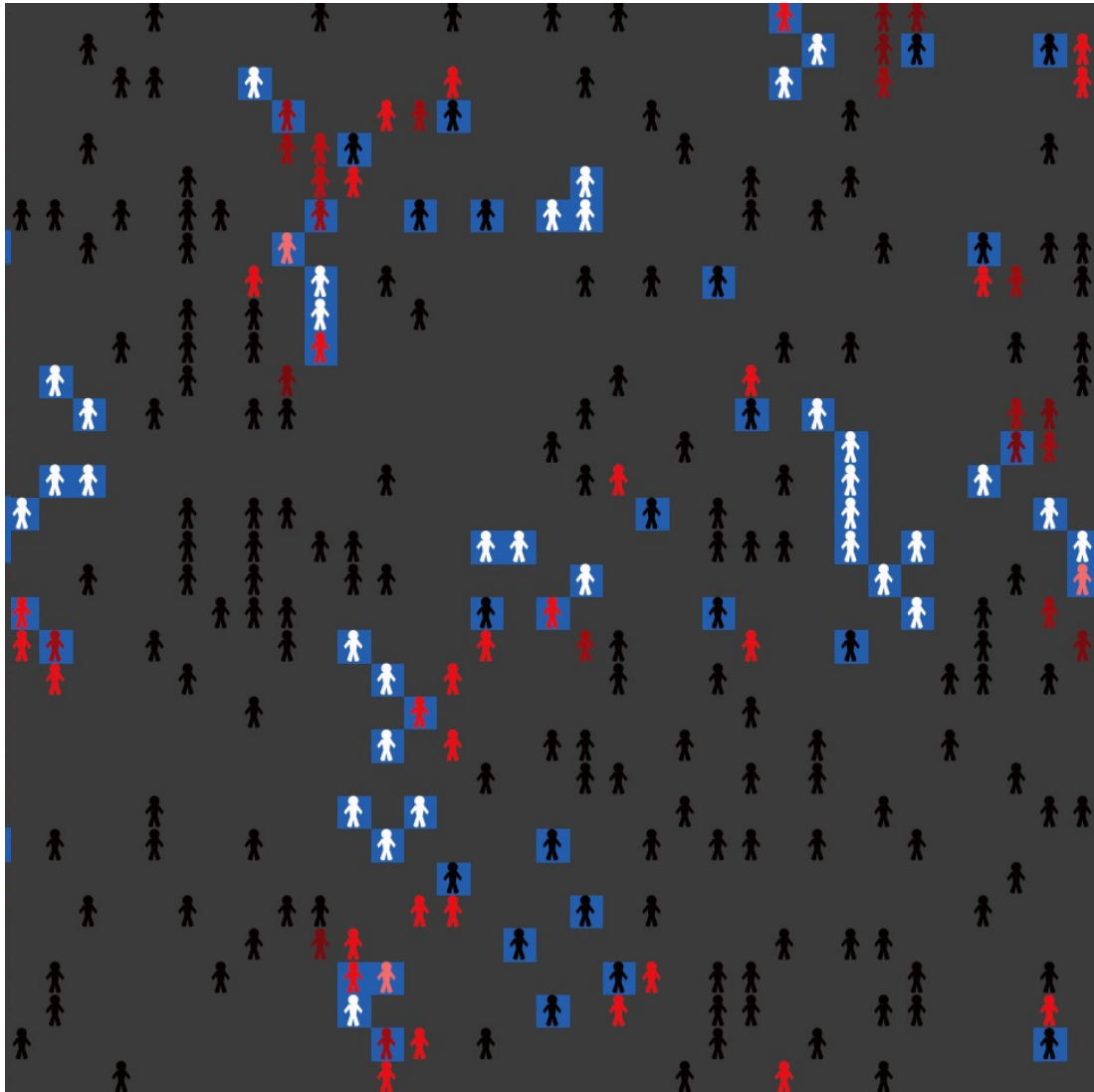
john.bernau@emory.edu

Figure 1: Equilibrium State for Dense Social Influence World



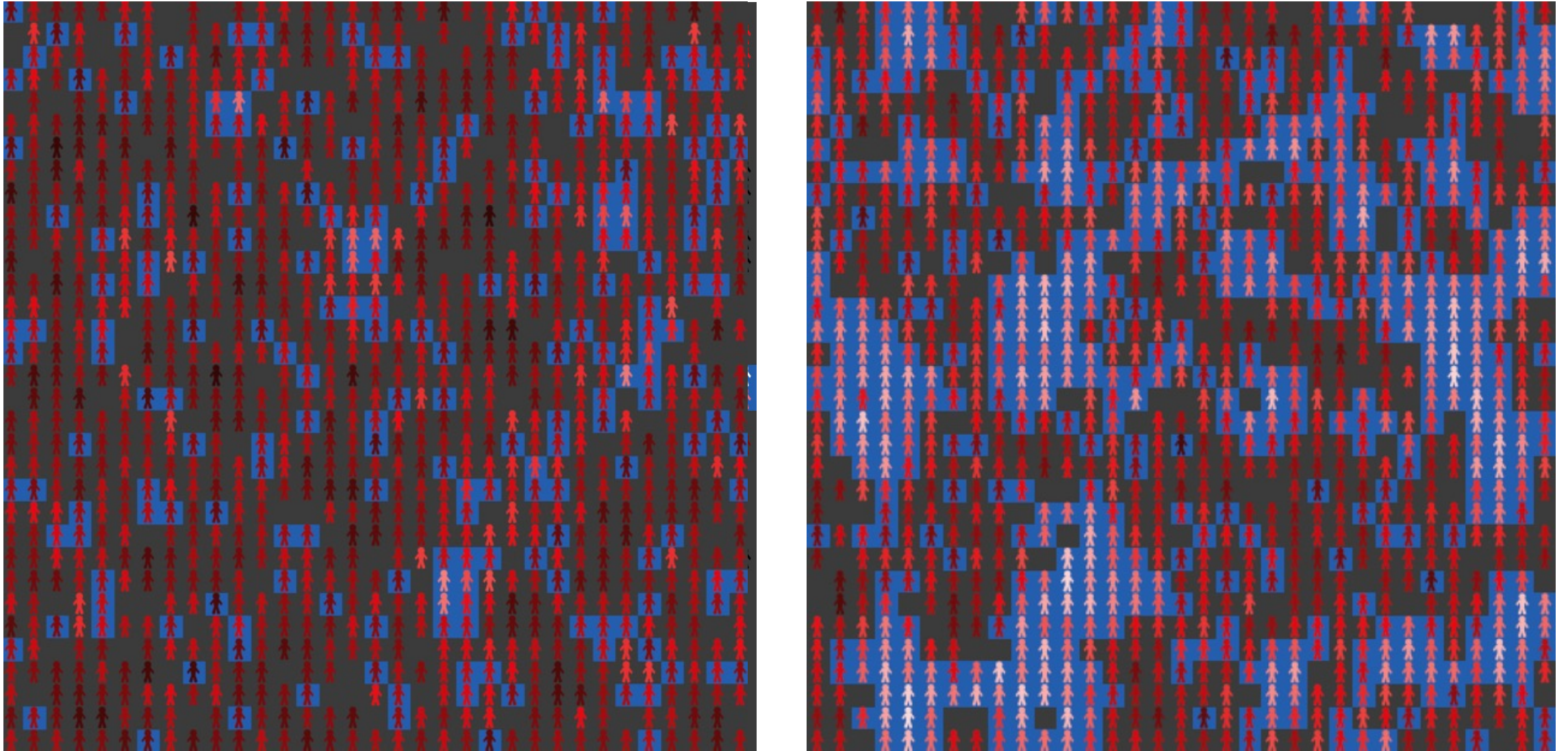
Note: Attendance signified by blue square, religious demand ranges from white (high) to black (low). $N = 1000$, social influence = 1. (a) begins with 20% attendance and ends with around 22%, (b) begins with 40% and ends with around 80%.

Figure 2: Equilibrium State for Sparse Social Influence World



Note: Attendance signified by blue square, religious demand ranges from white (high) to black (low). $N = 250$, social influence = 1. (a) begins with 20% attendance and ends with around 30%, (b) begins with 40% and ends with around 60%.

Figure 3: Equilibrium State for Dense World with Random Normal SI and IR



Note: Attendance signified by blue square, religious demand ranges from white (high) to black (low). $N = 1000$, social influence and individual religiosity distributed $N(0.5, 0.01)$. (a) begins with 20% attendance and ends with around 22%, (b) begins with 40% and ends with around 50%.